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ANNUAL REPORT

OF THE

State Engineer and Surveyor

125577

FOR THE

Fisca[illegible]ding Sept. 30, 1891.

With Compliments of

JOHN BOGART,

71 Broadway, New York.

12, 1892.

ALBANY:
JAMES B. LYON, STATE PRINTER.
1892.

STATE OF NEW YOR

No. 75.

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MARCH 1

ANNUAL REPORT

OF THE

STATE ENGINEER AND SURV

STATE OF NEW YORK:
OFFICE OF THE STATE ENGINEER AND SUR
ALBANY, N. Y., *December* 15, 189

To the Honorable the Speaker of the Assembly:

SIR.— I have the honor to submit herewith my ann
for the fiscal year ending September 30, 1891.

Very respectfully,
Your obedient servant.
JOHN BOGART
State Engineer and S

REPORT.

Office of the State Engineer and Surveyor,
Albany, N. Y., *December* 31, 1891.

To the Honorable the Legislature of the State of New York:

I have the honor to present my fourth annual report as State Engineer of the State of New York, being my final report as the incumbent of that office.

Intrusted with varied responsibilities, referred to hereinafter in some detail, the most constantly important function of this Department has been and still is the charge and direction of the engineering service connected with the design, the construction, the improvement and the maintenance of the great system of artificial internal water communications constructed, owned and maintained by the State of New York.

The Commercial Canals of New York.

These canals have had a permanent beneficial influence upon the advance and prosperity not only of this State, but also of the great and constantly growing communities whose products pass through these waters. No other State possesses any system of similar magnitude, nor has any nation so extensively developed and maintained the opportunities for artificial internal water commerce within its boundaries as has the State of New York. First begun in 1791, by the improvement of the connection between the Mohawk river and Lake Ontario, the system has been expanded and enlarged with few interruptions up to the present time. In 1825 the first boat passed from Lake Erie to the Hudson, and in 1828 the Oswego canal, from Lake Ontario to its junction with the Erie canal at Syracuse, was opened. The Champlain canal, from Lake Champlain to the Hudson at Albany, was finished in 1823.

The canals now owned and maintained in navigable condition by the State of New York have a length of over 628 miles, and there are connected with them 2,160 structures, including 44 aqueducts, 280 locks, with an aggregate lift of 2,366 feet, 85 dams, 1,109 bridges and 642 other structures, such as culverts, waste-weirs, etc.

The Erie canal of 1825 had a width at bottom of twenty-eight feet, at water surface forty feet, depth of water four feet, extreme length of locks ninety feet, width of locks fifteen feet, and carried boats with a capacity of eighty tons.

The present Erie canal has a width at bottom of fifty-two and one-half feet, at water surface seventy feet, depth of water seven feet, extreme length of locks 110 feet, width of locks eighteen feet, and carries boats of a capacity of 250 tons.

The carrying capacity of the canals has been increased not only by this enlargement, but also by the introduction of the method of towage in fleets, by the use of steam propulsion and by doubling the length of a number of the locks.

The improvements which have recently been in progress have been defined by the various acts of the Legislatures which, during a number of years, have made appropriations for these purposes.

For the Erie and Oswego canals the principal features of these improvements have been, the lengthening of the locks so as to pass two boats coupled together, and also the removal of bars and other deposits and raising the banks to the proper height to secure the full standard depth of seven feet of water.

Upon the Champlain canal the work directed by the Legislature has been the improvement of the alignment which at many places was very tortuous, and the reconstruction necessary to give the canal a standard width of forty-four feet at the bottom and a depth of water of six feet. Improvements have also been made upon the other canals of the State, but not so as to increase their standard dimensions.

For the first time in a number of years the Legislature has not, this past year, made similar appropriations, and therefore only those works which were in progress, or were directed by former statutes, have been prosecuted.

The interruption of these works of improvement, though probably temporary, suggests a reference to some of the projects which have been considered in connection with the State canals, with a view to increase their usefulness in the transfer of the products of our great west to tidewater.

With special reference to the Erie canal, the improvements which have heretofore been authorized by the Legislature, are based on the project of a finished canal to have seven feet depth of water, and to have locks of sufficient length to pass at once two boats coupled together, each boat being ninety-eight feet long.* There could then be passed through the canal boats of 250 tons capacity, coupled together so as to be virtually the same as boats of 500 tons. With the improvement completed upon this basis, the means to increase the carrying capacity of the canal would be sought in methods for applying steam power in better form and with better and more economical results than are now secured by the existing boats propelled and towed by steam.

Recent developments in the economical transmission of power by electricity suggest the possibility of its application in some form to the propulsion of boats on this improved canal. Such improvements in steam propulsion and the possible use of electric propulsion seem to be the additional practical possibilities towards reducing the cost of transportation between the lakes and tidewater through the canal of the present standard dimensions.

Enlargements of these standard dimensions have been suggested by State Engineers at various times, mainly with the view of securing additional depth of water to the extent of one or two feet, thus making the standard depth eight or nine feet instead of seven feet as at present. Estimates have been presented to previous Legislatures showing the probable cost of such increase in depth and plans have been prepared of practicable methods for giving such increased depth. In the annual report of State Engineer Seymour for 1878 is included a report by E. Sweet, Jr., then division engineer and later my immediate predecessor as State Engineer giving the results of experiments made to determine the difference in motive power and the increased carrying capacity of the canals, should the depth of water be increased one foot. In a paper read before the American Society of Civil Engineers, June 17, 1879 (Trans. Am. Soc. C. E., Vol. IX), Mr. Elnathan Sweet, Jr., gives in full detail these results and deductions, together with the estimated cost of the improvement. He concludes that the benefit which would accrue in the canal business of a single year should such increase in depth be made, would nearly repay all the cost of such improvement.

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* NOTE.—At two points, Cohoes and Lockport, the present locks, which can pass but one boat at a time, are so connected as to make their lengthening very expensive. At all other points this improvement can be made without very serious difficulty.

The Legislature has not, however, authorized any increase in the depth of the Erie canal.

A far more radical change in the method of water communication through the State of New York between the lakes and the sea has been much discussed. This is the construction of a canal of sufficient capacity to convey lake vessels to tide-water. Much information has been gathered and presented to the public through technical papers and the general press. The paper by Mr. Sweet and the extended discussions by eminent engineers in the transactions of the American Society of Civil Engineers, Vol. XIV, give full and valuable data and suggestive consideration to the various phases of this most important question. But this present report must rather deal with what has been accomplished and the temptation to even summarize the present condition of the discussion on this great possible improvement is resisted.

Methods of Transportation on the Canals.

STANDARD DIMENSIONS.

The present standard section of the Erie canal has a depth of water of seven feet, and a width at water line of seventy feet. The slope of the banks on each side of the canal is one and one-fourth horizontal to one vertical, giving a bottom width of fifty-two and a half feet. The banks are paved with what is called a "slope wall," generally built of boulder stones of moderate size, or of quarry stones, as may best be obtained from the country through which the canal passes, and these walls are continued to the top and rounded over the edge of the bank, the normal height being two feet above the water surface. The tow-path is generally eighteen feet in width, and slopes six inches away from the canal in this width. The berme bank is twelve feet in width, with a similar slope. These are standard widths, and in the improvement of the canal are secured wherever practicable. Where the canal passes through towns and at some other points, the slope wall is replaced by a wall vertical on the rear and with a slight batter on the water side, generally three inches to a foot, giving an opportunity for boats to receive and discharge their cargoes. The width at the water surface is maintained at the standard of seventy feet where this vertical wall is used. There are many points along the canals where the widths greatly exceed these dimensions, these areas of wide water being made use of as storage basins to maintain the levels and prevent serious fluctuations of depth, which might otherwise be caused by the lockages.

These standard dimensions apply to the Erie canal throughout its entire length of 352.18 miles, to the Oswego canal, thirty-eight miles, and to the Cayuga and Seneca canal, twenty-three miles. The Champlain canal, sixty-five and seventy-five hundredths miles in length, will have, when the improvements now in progress are completed, a depth of water of six feet and a bottom width of forty-four feet, the slope and vertical walls being of the same section as those on the Erie canal. The Champlain canal has had a five-foot depth of water before the present improvement. The Black River canal and its connections, over ninety miles long, has a depth of water of four feet.

PROFILE OF THE ERIE CANAL.

The current of the Erie canal flows easterly with the heavily loaded boats, from its westerly termination at Buffalo, 153.5 miles, to the Seneca river, there being in this distance nineteen locks, with a total descent from the level of Lake Erie of 180.16 feet. Two locks then give an ascent of sixteen and five-tenths feet to a short summit level fed from neighboring storage lakes. There is then a descent by one lock of eight and eighty-seven hundredths feet to the low level at Syracuse, which is 168 miles from the eastern end of the canal at Albany and 184.18 miles from Buffalo. Three locks, with a total ascent of seventeen and seven-tenths feet, bring the traffic to a long summit level of fifty-six miles, fed from the stored streams of the Adirondacks, and from this level the descent is continuous through forty-six locks, with a total fall of 428.4 feet, to the river level at Albany. The total length of the main line of the Erie canal is 352.18 miles and the difference of elevation between the Hudson river, at Albany, and Lake Erie, at Buffalo, is 572.23 feet.

The current in the canal varies from a scarcely perceptible movement at certain points to a velocity of one and two-tenths miles per hour; this latter, however, occurring only at one point where, for a short distance, the waterway is contracted to a rectangular section of sixty-two feet in width in the very heavy rock cut west of Lockport.

Early Improvements of Water Communication in the State of New York.

The project for improving water communication within the State of New York was suggested by Elkanah Watson, in 1788 the route proposed being by the Mohawk river to Fort Stanwix, now the city of Rome, and thence by Wood's creek, Oneida lake, Oneida river, the Seneca and Oswego rivers, to Lake Ontario.*

In 1791, at the suggestion of Governor George Clinton, a law was passed, probably the first canal law in this State, authorizing the Commissioners of the Land Office to cause to be explored the routes, both for the canal alluded to above and also for a connection between the Hudson river and Lake Champlain. Transportation beyond Rome then involved a portage of two miles. The report of the commissioners under this law resulted in the passage of a law creating two navigation companies, the one "for the purpose of opening a lock navigation from the now navigable part of the Hudson river, to be extended to Lake Ontario and the Seneca lake," this company being called the Western Inland Lock Navigation Company; the other from "the now navigable part of the Hudson river to Lake Champlain," this company to be called the Northern Inland Lock Navigation Company. The State afterwards subscribed to the stock of these companies and made loans, and in 1796 the route from Schenectady to Seneca Falls was opened for boats carrying sixteen tons. This improvement included a canal and locks at Little Falls, the locks being at first of wood, then of brick, but finally built of stone, the remains of which still exist. The commissioners who conducted the surveys and directed the work for this early improvement were General Philip Schuyler, Messrs. Goldsborrow Banyer and Elkanah Watson. The rebuilding of the locks in stone was done under the direction of Weston, an English engineer. Dividends were paid for a number of years upon the stock of the company which made these improvements. The toll paid to this company for a barrel of flour passing 100 miles was fifty-two cents and for a ton of goods, five dollars and seventy-five cents.

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* Reference is made to a valuable and interesting historical sketch of the New York State canals, by Sylvanus H. Sweet, Deputy State Engineer and Surveyor (afterwards State Engineer and Surveyor), published with the annual report of the State Engineer and Surveyor for 1862.

The establishment of this water communication was considered as tending to greatly increase the importance of the port of New York and led to action by the Pennsylvania Legislature towards an improvement of the internal navigation in that State. Under acts of the Legislature of New York, between 1812 and 1820 and negotiations by commissioners on the part of the State, the property of the Western Inland Lock Navigation Company, which controlled these improvements, passed into the hands of the State by payment under an appraisal.

Original Suggestion of the Erie Canal.

All this work was in the direction of the improvement of natural channels, the extent of artificial channels on the whole route being only fifteen miles. The idea of a great canal to connect Lake Erie with tidewater in the Hudson probably originated with Mr. Gouverneur Morris in 1803; in 1807 Mr. Jesse Hawley wrote a series of articles upon this question and in 1808 the Legislature of the State, on the motion of Mr. Joshua Forman, of Onondaga, directed the Surveyor-General, Simeon DeWitt, to make a survey for such a route. Mr. DeWitt appointed Mr. James Geddes as the engineer to make such survey, who made a report on January 20, 1809, in consequence of which the Legislature in 1810 appointed the following commissioners to prosecute the examinations: Gouverneur Morris, Stephen Van Rensselaer, De Witt Clinton, Simeon De Witt, William North, Thomas Eddy and Peter B. Porter, and Mr. Geddes was continued as the engineer.

This commission made their first report, written by Mr. Gouverneur Morris, March, 1811. After discussing the route from the Hudson to Lake Ontario it recommended the inland route to Lake Erie, with a direct descent from Lake Erie to the Hudson river. When the report was read to the Legislature, a bill was introduced by DeWitt Clinton and passed April 8, 1811, appointing the same commissioners with the addition of Robert R. Livingston and Robert Fulton, extending their powers and adding to the appropriations for their work. These commissioners made application to Congress and the Legislatures of the States and territories for aid, which was not given, the War of 1812 then occurring, but there were cessions of land made within the State by private owners for the purpose of aiding the construction of the canal.

Little was done until 1816 when a most interesting memorial written by De Witt Clinton was presented to the Legislature from the city of New York, urging action towards the construction of a canal from Lake Erie and suggesting that a serious objection to the Ontario route was that it would enrich a foreign power at the expense of the United States. Many statistics as to the then existing canals of the world were included in this memorial. There was also presented at the same time a report by Mr. Stephen Van Rensselaer, including data furnished by Mr. James Geddes, the engineer in charge of the surveys from Lake Erie to the Cayuga marshes, and Mr. Benjamin Wright, the engineer in charge from the Cayuga marshes to the Hudson river. The report urged the prosecution of work upon both the Erie and the Champlain canals. A canal law was passed April 17, 1816, creating a board of canal commissioners, which board entered at once upon its duties, with DeWitt Clinton as president. The dimensions of the proposed canals were fixed by these commissioners; for the Erie, a bottom width of twenty-eight feet, surface width of forty feet and depth of four feet; locks ninety feet in length and fifteen feet wide; for the Champlain canal, the width to be twenty feet at bottom, thirty feet at surface, with three feet depth; locks seventy-five feet long and ten feet wide.

Creation of Canal Fund and Construction of the Canals.

In 1816 DeWitt Clinton was elected Governor of the State. In response to a request of a joint committee of the Legislature, on March 10, 1817, he presented a system of finance for a canal fund which formed the basis of the law of April 15, 1817, by the provisions of which the then commission was retained in office, and the creation of a funded canal debt authorized, with certain taxes to be applied to the construction of the canal.

The first ground was broken, for the Erie canal, at Rome, July 4, 1817, by the Governor, and the middle section, from Utica to the Seneca river, was completed October 22, 1819, a boat then coming from Rome to Utica. This boat was called the "Chief Engineer;" it was built only to carry passengers, was sixty-one feet in length, seven and one-half feet wide and was drawn by a single horse.

The Champlain canal was opened, in part, for navigation November 24, 1819. Mr. Canvass White, as engineer, explored the route for the Erie from Seneca river west to the Genesee in 1819. David Thomas, engineer, made the final location of the Erie canal west from the Seneca river to Rochester in 1821, under the general direction of Messrs. James Geddes, Benjamin Wright and Canvass White. Mr. Canvass White introduced the use of hydraulic cement in the construction of the locks and other masonry in

1819, he having discovered in central New York in 1818 a stone from which it was manufactured.

Completion of the Canals.

On the 14th of October, 1822, the canal on the Irondequoit embankment east of Rochester, seventy feet in height, was first filled with water from the Genesee river and then for the first time navigation was carried through from Rochester to Little Falls, and on the 15th of November, 1822, it was extended from Little Falls to Schenectady. In 1823, the Champlain canal was completed from Lake Champlain to Albany and on October 26, 1825, the Erie canal was completed from Buffalo to the Hudson, the western section having been delayed on account of the deep rock cutting west of Lockport and the construction of the five combined locks at that place.

The completion of the canal was celebrated with great enthusiasm. The first boat from Buffalo arrived at Albany on November 23, 1825. Its passage was celebrated at every point along the route. It carried DeWitt Clinton, whose enlightened energy and perseverance, aided by the remarkable skill of the engineers associated with him, had carried this great work to a successful completion. The actual construction cost of the Erie and Champlain canals was reported as $7,853,099, there being additional expenditures charged to the canal fund for purposes other than construction of $1,621,274.

The Oswego canal from Syracuse to Lake Ontario was completed and opened December 10, 1828; the Cayuga and Seneca canal was completed and navigation opened on November 15, 1828. The Chemung canal was completed September 10, 1831, and the Crooked Lake canal in 1833.

Enlargement of the Canals.

In 1835, a series of investigations were made with reference to enlargements of the Erie canal and reports were made by Messrs. Bouck and Hoffman, canal commissioners, and Messrs. John B. Jervis, Holmes Hutchinson, Frederick C. Mills and

Nathan S. Roberts, as engineers, upon the subject. The Legislature passed a law authorizing the canal commissioners to enlarge the Erie canal and construct double locks upon it and, based upon the reports above referred to, the dimensions of the enlarged canal were fixed at seventy feet width at water surface, with a depth of seven feet of water, the locks to be 110 feet long and eighteen feet wide. It was estimated that this enlargement would save fifty per cent in cost of transportation, exclusive of tolls. The enlargement of the canals to this standard width and depth was begun in 1836 and was continued up to 1842, when the Legislature directed a suspension of expenditures. Work then in progress, however, was continued and in 1847 the work of enlargement was resumed and was substantially completed in 1862. Since that time there has been no change in the standard of width at water line of seventy feet, or depth of seven feet.

As stated above, the recent improvement has been the lengthening of one of each of the twin locks so as to pass two coupled boats at each lock. Thirty-eight of the seventy-two locks of the Erie canal have thus been lengthened.

Size and Tonnage of Boats.

The Erie canal, as first constructed, permitted the passage of boats seventy-eight feet eight inches long, fourteen feet five inches wide and three feet five inches draught, with a capacity of eighty tons. The present canal carries boats ninety-eight feet long, seventeen and one-half feet beam and six feet draught, with a capacity of 250 tons; the capacity of most of the boats, however, is 240 tons. The boats are now constructed to the full carrying capacity which the dimensions of the locks permit.

Introduction of Steam Propulsion.

Animal propulsion was the only method in use on the canal up to about 1871, with the exception of some small passenger-boats in which steam was used, but not for the transportation of freight, except perhaps, experimentally. In 1871, the Legislature created a commission to test and examine inventions and devices by which steam or any other motor than animal power might be practically and profitably applied in the propulsion of boats upon the canals and providing for the payment of an award of $100,000 for such inventions or devices not exceeding three in number, as should, in the opinion of this commission be satisfactorily adapted to the purpose. These inventions or devices were to be tried at the cost of the parties offering them for trial; they were to actually transport at least 200 tons of cargo; they were to have a rate of speed not less than an average of three miles per hour, without injury to the canals; they were to be easily stopped or backed; simplicity, economy and durability were to be elements considered and they were to be readily adapted to the existing canal boats, and, finally, they were, in the opinion of the commission, to lessen the cost of canal propulsion and increase the capacity of the canals. This commission consisted of Messrs. George B. McClellan, Horatio Seymour, Erastus S. Prosser, David Dows, George Geddes, Van R. Richmond, Willis S. Nelson, George W. Chapman, William W. Wright and John D. Fay. Mr. David M. Greene was appointed engineer to this commission.

It had been quite generally supposed that one of the chief difficulties to be overcome in the application of steam to the propulsion of canal boats was the swell or wave which would be created by the machinery of propulsion and the consequent damage to the banks of the canal. It was soon found that this difficulty did not exist to any appreciable extent at the speed mentioned. A wave or swell is caused very much more by high speed than by the machinery of propulsion; in fact boats now carrying freight and navigating the canal by steam power cause no appreciable injury to the banks. Occasional boats carrying passengers and light freight and running at a high rate of speed do cause waves which are injurious.

Many models for wheels and for modifying the shape of boats with the purpose of preventing this wave were submitted to the commission, and it was found necessary to adopt a resolution to the effect that there was no particular difficulty in navigating the canals by boats carrying 200 tons cargo at the rate of three miles per hour, so far as regards injury to the canals or their structures, the main point to be considered being the economy of steam or other motor as compared with animal power. As stated above, experience and observation for a number of years has justified this conclusion, so far as regards the speed attained by any boats in ordinary use on the canals of the State of New York.

During the first season of the commission's existence there was but one steamboat officially considered and this steamer had the screw in the bow, forcing the water back through a passage underneath the boat. During the second season, in 1872, twelve steamers were presented for observation, only three of which, however, made the three round trips between New York and Buffalo and return required. One of these, the "William Newman," had a capacity at six feet draught of 214 tons, a single upright engine, twelve inches in diameter and twelve inches stroke, and a screw four-bladed, five feet in diameter with seven feet pitch; the boiler was horizontal, return tubular, eight feet long, four feet in diameter. Another steamer, the "William Baxter," 207 tons, had a compound condensing engine, cylinders seven and twelve inches in diameter with a stroke of twelve inches, a boiler seven feet high and forty-six and one-half inches in diameter with a hull of somewhat peculiar shape. The Baxter had two three-bladed screws four and one-half feet in diameter with four feet pitch, and the machinery was controlled by the steersman. The steamer "Port Byron," had a concave bow below the water line, a rectangular trunk along the bottom of the boat, terminating in a recess cut in the stern for a feathering paddle-wheel by which the steamer was propelled. This was ten feet in diameter with paddles of boiler iron three feet six inches long and two feet four inches wide. The engine was double, non-condensing, twelve inches in diameter and twenty-four-inch stroke. The "Charles Hemje" 201 tons, single upright, non-condensing engine, four-bladed screw, four feet six inches in diameter, six feet six inches pitch, had a cylindrical casing of boiler iron with a horizontal axis, but held on a vertical axis about the screw and independent of it, which cylinder replaced the ordinary rudder, the boat being steered by the force of the water expelled by the screw and passing through this cylinder. The "Fountain City" was propelled and steered by two stern paddle-wheels, revolving towards each other about vertical axes. The "Eureka" was propelled by two screws located in the bow, but was not successful. The "George A. Feeter" had channel-ways in the hull for the passage of water but was not successful. The "Central City" had adjustable paddle-wheels placed in recesses at the side of the stern, with arrangements by which the machinery, including the wheels, could be raised and depressed.

The report by Mr. D. M. Greene for 1872 has much valuable information. The conclusion of the commission for that season was that the time had not been fairly sufficient for complete trials, as intended under the law and therefore no awards were made, but it was recommended to the Legislature that the experiments should be continued. The Legislature did at the session of 1873, pass an act continuing the powers of the commission during that season. Several new boats were brought forward. The "C. C. Pope" was an ordinary full-sized lake boat, carrying 202 tons with single engine, cylinder ten inches, stroke twelve inches, boiler eleven feet long and four feet diameter; the screw was four bladed, six feet diameter, six feet pitch and the screw and rudder were adjustable so as to secure complete immersion at any draught. This device, however, did not seem to be satisfactory. The "C. C. Smith" was similar to the Fountain City and did not succeed. The "Peter Cooper" was similar to the Port Byron. The "A. A. Webster" was much like the Dawson, with the screw in a cavity in the bow, but it was found that she ran better stern foremost and she was run that way during the season. The "City of New York" was built by Mr. Baxter on the plan of the William Baxter described above, but somewhat larger and had two high-pressure cylinders and one low-pressure cylinder, four and three-fourths inches and fourteen inches in diameter and fourteen inches stroke, with a vertical boiler seven feet by forty-eight and three-fourths inches. It was propelled by a single four-bladed screw.

The results obtained by this commission are given in an appendix to this report in some detail. They are briefly as follows: One of the requirements of the commission was that each boat should make three round trips between Buffalo or Oswego and New York. Only the Baxter, the Newman, the Port Byron and the Dawson made these three trips. The commission determined not to make an award to either of these boats, but adopted as the opinion of the commission, resolutions to the effect that the "inventions, devices and arrangements of machinery of the boat William Baxter are the best adapted to fulfill the objects sought to be secured by the law, and those of the boat William Newman, have given highly satisfactory results and possess great merit." The commission also recommended to the Legislature the enactment of a law terminating the work of the commission and making an award under certain conditions. The Legislature did pass in June, 1874, such a law providing that there should be paid to William Baxter the sum of $35,000, provided that he should place upon the canals of the State during the season of 1874, seven steamboats, fully equipped and in all respects equal in power and capacity to the steam canal boat City of New York, and to David B. Dobbins, the sum of $15,000, provided that he should place upon the canals of the State three steamboats, fully equipped and in all respects equal in power and capacity to the steam canal boat William Newman; and to Theodore D. Davis, the sum of $5,000, provided that he should place upon the canals of the State during the season of 1874, one steamboat fully equal in power and capacity to the steam canal boat Central City. The provisions of this law were duly complied with by the persons named; the certificates were made and the awards paid.

The work of this commission, as outlined above, resulted in a permanent introduction of steam propellers upon the Erie canal and the boats placed upon the canals under these auspices have continued in active service and have been the models for improvements which have since been made.

These improvements, however, have not been of great extent, so far as machinery for propulsion is concerned.

DOUBLE HEADERS.

The introduction of boats running in pairs coupled together has been of great importance. This applies to boats propelled by animal power as well as to those propelled by steam. This method was introduced about 1877. The original plan was patented by Mr. William Frick of Chester, Pa. He coupled two boats, the one directly behind the other, by ropes which were connected with the rudder of the rear boat and with a steering wheel upon the forward boat in such a way that the rudder would be moved and the boats form such angles with each other as would enable them to readily turn and pass curves, or other boats. Another method of coupling boats, called the Illinois system, because it originated upon the Illinois and Michigan canal, couples the two boats rigidly together, steering the first boat by the rudder of the rear boat. A modification of the Frick plan is the one now in general use. The two boats are connected by ropes running from the stern of the forward boat, through blocks on each side of the rear boat and returning to a wheel on the forward boat; these ropes are not connected with the rudder of the rear boat, which is left free and the boats are steered by using the rear boat as the rudder. This plan is very successful. Most of the better class of the recently built canal boats, propelled by animal power, adopt this plan, securing thereby considerable economy over single boats. The single boat requires for continuous running a crew of at least four men and four horses or mules, two in service and two in reserve; the "double header" or coupled boats requires no more crew and but two more horses, three being used in a team. The boats now in use and which carry the greater portion of the Erie canal freight are such "double headers," each boat being of about 240 tons capacity, although the more recently built boats have a capacity of 250 tons, these being as large as can be passed through the present locks. The two boats thus coupled are towed by three horses or mules, each team working twelve hours a day. These boats require nine to ten days for the run from Buffalo to West Troy or Albany. At Albany the boats are made into fleets and towed to New York, the rest of the trip taking about three days, thus making the running time for a round trip about twenty-five days, including ordinary delays. The boats therefore have but five days for the ports of Buffalo and New York to complete a trip in one month. The ordinary canal season, May first to December first, would therefore give opportunity for seven trips of such boats, if there should happen to be no special delay, but as such delays almost invariably occur at some time during the season, either from breaks, or damage to the boats, or loss of time in receiving and discharging cargo, the usual number of trips is reduced to six.

STEAM FLEETS.

The same method of coupling two boats together, the one in front of the other, is used with the boats propelled by steam power, except that the coupling generally employed in connecting a steamer and its immediate consort is more rigid, being a connecting arm of wood on each side of the bow of the steamer, attached to the stern of its consort which is pushed by the steamer, the steamer thus pushing one ordinary freight boat and towing either one, two, three or four other ordinary boats. The boats are towed by hawsers five inches in circumference and from 300 to 500 feet long. The general arrangement with steamers of the power now in use on the canal is that the steamer pushes a consort and tows two boats connected together. The trip by such a fleet through the canals occurs as follows: The boats, including the steamer, being loaded at Buffalo and connected in the way indicated, run without interruption the distance of thirty-two miles to the head of the five combined locks at Lockport. Here the boats must be separated and each passes alone through the locks, as the length of each of these locks is only sufficient to pass one boat. At the foot of the Lockport locks the fleet is again connected and passed to Newark, 97.42 miles, without disconnecting the double-headers, the eight locks between those points having been doubled in length so as to permit the passage of two boats coupled together. At Newark there are three locks not yet lengthened, with short levels of 840 and 720 feet between them, and to pass these the boats have again to be uncoupled; there is then a distance of 136.38 miles to Little Falls, the eighteen locks upon which have been lengthened and through which the boats pass without separation. At Little Falls there are four locks separated by levels of 3160, 740 and 1035 feet which locks have not been lengthened. From the foot of these locks to the upper Mohawk aqueduct below Schenectady, a distance of 56.93 miles, the eleven locks have been lengthened. None of the twenty-two locks between this point and Albany have, as yet, been lengthened and therefore the boats that pass through them have to separate. Sixteen of these locks at Cohoes are very close together, separated by levels from 590 to 640 feet in length, and in passing from one to the other of these the boats are not coupled. The boats generally pass into the Hudson river at West Troy and are towed from thence to Albany in the river, although the eastern terminus of the Erie canal is at the basin in the city of Albany. The fleet of four boats upon entering the river, is made up into a compact form, one boat being in front with two boats at each side, the bows of these overlapping the stern of the forward boat and the steamer being in the rear, with her bow between the two side boats. In this way the steamer handles all as if they were one craft and takes them to the harbor of New York with ease.

The canal steamer of 1891 is, in general appearance, similar to the best class of the canal boats propelled by horses, except that it has finer lines, both at bow and stern, and different interior arrangements. The frames are generally of oak, the ribs being three or four inch timber, spaced about fifteen inches and planked with two inch oak in long pieces. Some of the boats have oak frames at bow and stern, with the mid-rib portion of five-inch pine, bolted together with long vertical bolts. The cabin used by the master and family is generally forward, with an apartment for the use of the crew. The pilot house is usually placed over the boiler-room. The boilers are either horizontal tubular, about eight feet long and eight and one-half feet in diameter, or vertical, of a special type having a central cylindrical magazine which is filled with coal from the top. These boilers are from nine and one-half to eleven and one-half feet in height and from fifty-four to sixty-six inches in diameter and have about 100 two and one-half-inch direct tubes and about thirty-five three-inch return tubes. These boilers have a small blower. The screws are about six feet in diameter and with a pitch of from six to seven and one-half feet. One kind of boats has a screw formed by a circular disc four feet in diameter with a flange on one side of the circumference to which four blades, about two feet long, are bolted. This screw being eight feet in diameter and the draught of the boat never exceeding six feet, and often, when running light, not much more than one foot, the blades rise at least two feet above the water and lose a large proportion of their propelling power. The engines of most of the boats are simple condensing engines with cylinders of twelve to fourteen inches diameter and sixteen inches stroke, having cut-off arrangements, feed water heaters and surface condensers. The water for condensing is circulated through a passage in the bottom of the boat and thence through the condenser by a pipe ending just forward of the screw. The water is forced through this apparatus by the combined motion of the boat and the screw. This arrangement is quite successful, creating, when in good condition, a vacuum of twenty-four inches. Some of the more recent boats have compound engines, with a high-pressure cylinder, ten inches; low-pressure, eighteen inches in diameter, and a common stroke of fourteen inches. The valves are rotary, three in number, the upper one being adjustable. A table, "A," attached gives the names, dimensions and other data relating to twenty-nine steamers in active service upon the Erie canal:

TABLE

DATA AS TO SOME OF THE STEAM CANAL

Number.	NAME.	Master	Owner.
1	Acme	M. Depuy	M. Depuy
2	Columbia	Wm. A Fish	F. Beadle
3	Lizzie Crandall	E. B. Tuttle	E. B. Tuttle
4	Carrie Stewart	Robt A. Jewell	Robt. A. Jewell
5	John B. Dallas	A. C. Torrance	A. C. Torrance & Son
6	Aug. Demorest	Boyd H. Wood	Boyd H. Wood
7	Wm. Baxter	Robt. O. Christian	Mary Christian
8	Wm. Spencer	William Hickok	Elizabeth Hickok
9	A. J. Wright	J. R. Tuttle	Lydia M. Hathaway
10	Stranger	Louis R. Rector	Hattie A Rector
11	Walston	Timothy Raftery	Timothy Raftery
12	Wm. E. Cleary	Winfield H. Scott	Winfield H. Scott
13	Ridgway	E. D. Fiske	E. D. Fiske
14	City of Milwaukee	Dawson J. Blair	Dawson J. Blair
15	James W. Morse	Edgar Van Buren	Edgar Van Buren
16	Geo. W. Dimmers	Chas. Dimmers	Chas. Dimmers
17	Zenobia	S. T. Stacy	O. T. Stacy
18	Alfred Morgan	Wm. H. Cunningham	Wm. H. Cunningham
19	Arthur D. Bissell	G. R. Kill	G. R Kill
20	E. P. Cooke	Albert Scott	Michael Kelly
21	Dr. A. C. Hallam	Thomas Joyce	Matthew Joyce
22	Francis B Thurber	James J. Collins	Abi. Collins
23	John Lang	W. D. Jameson	George B. Johnson W. D. Jameson
24	Mahar & Burns	John C. Thomson	John T. Thomson John C. Thomson
25	Robert Rogers	Thomas Quigley	Thomas Quigley
26	H. C. French	Dick Williams	Michael Kelly
27	C. H. Dimmers	W. M. Cole	W. M. Cole
28	G. R. Green	R T. Campbell	R. T. Campbell
29	J. C. Austin	W. H. Kenny	W. H. Kenny

A.

BOATS NAVIGATING THE ERIE CANAL, 1891.

HULL BUILT —			TONS.		DIMENSIONS.		
By —	In —	At —	Gross.	Net.	Length.	Breadth.	Depth.
G. W. Hall....................	1891	Lockport, N. Y.......	128.09	103.07	....	....	.....
Morgan Bros..................	1889	Lockport, N. Y.......	130.41	109.43	92.7	17.4	9.2
G. W. Hall....................	1889	Lockport, N. Y.......	135.29	108.66	93.0	17 4	.8.6
Notter Bros..................	1890	Buffalo. N. Y.........	141.90	106.74	....	...	.....
Morgan Bros..................	1890	Lockport, N. Y......	127.15	91.54	....	....	.....
Notter Bros..................	1888	Buffalo, N. Y.........	122.81	112.46	92.8	17.8	8.0
....	1872	Fishkill, N. Y.........	116.93	73.76	95.7	17.2	9.5
Frank Stott............	1881	Havana, N. Y........	131.76	105.78	96.0	17.7	9.0
Notter Bros..................	1880	Buffalo, N. Y.........	130.68	106.33	96.0	17.8	8.6
Notter Bros.................	....	Buffalo, N. Y.........	135.00	105.81	94.2	17.8	9.2
Notter Bros.......	1883	Buffalo, N. Y.........	132.46	105.52	95 5	17.8	9.0
Morgan Bros..................	1887	Lockport, N. Y.......	140.65	110.88	96.0	17.5	9.0
Notter Bros.	1883	Buffalo, N. Y.........	135.37	107.67	95.0	17.8	9.2
....	1875	Buffalo, N. Y........	125.19	91.35	97.0	17.8	9.0
ra Betts......................	1888	Phœnix, N. Y	132.34	105.82	95.6	18.0	8.8
Chas. Dimmers..............	1890	Buffalo, N. Y.........	126.64	88.64	....	....	.....
Morgan Bros.........	1881	Lockport, N. Y.......	142.99	117.23	93.1	17.9	9.3
Morgan & Sutton............	1885	Lockport, N. Y.......	137.66	106.48	96.0	17.7	7.0
Benedict & Morgan...........	1881	Lockport, N. Y.......	137.43	112.21	96.0	17.8	9.2
G. W. Hall....................	1881	Havana, N. Y........	135.55	115.71	96.4	17.8	8.9
G. W. Hall....	1881	Hallam, N. Y.........	136.19	108.48	95.4	17.8	9.0
Morgan Bros.............. ..	1880	Lockport, N. Y.......	131.42	111.01	95.8	17.8	8.8
{ Fall Brook Coal Co.........	1875	Watkins, N. Y........	107.17	75.41	93.1	17.0	8.0
{ G. W. Hall.................	1887	Lockport, N. Y.......	137.02	109.44	96.6	17.8	8.9
Morgan Bros..................	1888	Lockport, N. Y.......	142.08	111.73	92.8	17.8	9.0
G. W. Hall....................	1885	Lockport, N Y.......	142.41	111.82	95.4	17.6	8.8
G. L. Dimmers................	1882	Buffalo, N. Y.........	133.48	105.97	96.4	17.8	9.1
G. W. Hall..................	1887	Lockport, N. Y.......	137.02	109.43	95.7	17.8	8.9
G. W. Hall....................	1886	Lockport, N. Y.......	100.21	98.00	95.0	17.7	8.8

TABLE A — *Data as to some of the steam canal*

Number.	NAME.	BOILER.		
		Built by —	At —	In —
1	Acme	G. W. Hall	Lockport, N. Y	1891
2	Columbia	G. W. Hall	Lockport, N. Y	1889
3	Lizzie Crandall	G. W. Hall	Lockport, N. Y	1890
4	Carrie Stewart	Geo. W. Tifft & Co	Buffalo, N. Y	1890
5	John B. Dallas	G. W. Hall	Lockport, N. Y	1890
6	Aug. Demorest	Geo. W. Tifft & Co	Buffalo, N. Y	.....
7	Wm. Baxter	Bigelow & Co	New Haven, Conn	1884
8	Wm. Spencer	A. O. Whitmore	Havana. N. Y.	1881
9	A. J. Wright	G. W. Hall	Lockport, N. Y	.....
10	Stranger	G. W. Tifft & Co	Buffalo, N. Y	1891
11	Walston	G. W. Tifft & Co	Buffalo, N. Y	1889
12	Wm. E. Cleary	G. W. Hall	Lockport, N. Y	1887
13	Ridgway	G. W. Hall	Lockport, N. Y	.....
14	City of Milwaukee	Lanigan & Oneill		1887
15	James W. Morse	G. W. Hall	Lockport, N. Y	1887
16	Geo. W. Dimmers		Tonawanda, N. Y	.....
17	Zenobia	G. W. Hall	Lockport, N. Y	1881
18	Alfred Morgan	G. W. Hall	Lockport, N. Y	1885
19	Arthur D. Bissell	G. W. Hall	Lockport, N. Y	1882
20	E. P. Cook	G. W. Hall	Havana, N. Y.	1881
21	Dr. A. C. Hallam	G. W. Hall	Lockport, N. Y	1881
22	Francis B. Thurber	G. W. Tifft & Co	Buffalo, N. Y	1880
23	John Lang	G. W. Hall	Lockport, N. Y	1888
24	Mahar & Burns	G. W. Hall	Lockport, N. Y	1886
25	Robert Rogers	G. W. Hall	Lockport, N. Y	1888
26	H. C. French	G. W. Hall	Lockport, N. Y	1888
27	C. H. Dimmers	A. O. Whitmore	Havana, N. Y.	1882
28	G. R. Green	G. W. Hall	Lockport, N. Y	1887
29	J. C. Austin	Lyon Co	Newark, N. J	1879

boats navigating the Erie canal, 1891 — (Continued).

BOILER.							
				TUBES.			
Kind.	Material.	Length.	Diameter.	Number.	Diameter.	Pressure allowed.	Draught.
Vertical	Iron	11' 7"	66"	38 R 38 D	3" 2½"	111	Blower.
Horizontal	Iron	....	......	62 R 124 D	3" 2½"	110	Natural.
Vertical	Iron	10' 0"	66"	38 R 38 D	3" 2½"	112	Blower.
Horizontal	Steel	8' 6"	66"	....	....	140	Natural.
Horizontal	Steel	8' 0"	72"	124	2½"	135	Natural.
Horizontal	Steel	7' 8"	66"	....	....	100	Natural.
Vertical	Iron	8' 0"	45"	....	....	80	Blower.
Vertical	Iron	10' 6"	30"	....	....	60	Blower.
Vertical	Iron	10' 0"	54"	77 D 20 R	2½" 3"	60	Blower.
Horizontal	Steel	7' 8"	66"	....	....	130	Natural.
Horizontal	Steel	8' 0"	66"	112	2½"	140	Natural.
Vertical	Iron	10' 6"	60"	32 R 100 D	3" 2½"	90	Blower.
Vertical	Iron	10' 6"	54"	20 R 77 D	3" 2½"	70	Blower.
Vertical	Iron	9' 6"	54"	....	....	135	Natural.
Vertical	Iron	10' 6"	60"	32 R 100 D	3" 2½"	90	Blower.
Horizontal	....	9' 6"	72"	70	3"	....	Natural.
Vertical	Iron	10' 6"	54"	20 R 77 D	3" 2½"	70	Blower.
Vertical	Iron	10' 0"	60"	32 R 100 D	3" 2½"	78	Blower.
Vertical	Iron	10' 0"	54"	20 R 77 D	3" 2½"	70	Blower.
Vertical	Iron	10' 6"	54"	20 R 77 D	3" 2½"	70	Blower.
Vertical	Iron	10' 6"	54"	20 R 77 D	3" 2½"	60	Blower.
Vertical	Steel	10' 0"	57"	118	2½"	90	Blower.
Horizontal	Iron	7' 8"	......	124	2½"	105	Natural.
Vertical	Iron	10' 0"	54"	20 R 77 D	3" 2½"	84	Blower.
Vertical	Iron	10' 6"	60"	32 100	3" 2½"	91	Blower.
Vertical	Iron	10' 6"	60"	32 100	3" 2½"	76	Blower.
Vertical	Iron	9' 6"	54"	....	....	80	Blower.
Vertical	Iron	10' 0"	54"	....	....	84	Blower.
Vertical	Iron	9' 6"	58"	....	....	90	Blower.

TABLE A — *Data as to some of the steam canal*

Number.	NAME.	SCREW.			ENGINE.	
		Diameter.	Pitch.	Number of blades.	Pattern.	Cylinder.
1	Acme	6′	6′ 0"	4	Simple condensing	14" x 16"
2	Columbia	6′	6′ 9"	4	Simple condensing	14" x 16"
3	Lizzie Crandall	6′	6′ 2"	4	Simple condensing	14" x 16"
4	Carrie Stewart	6′	6′ 9"	4	Compound	10" 18" x 14"
5	John B. Dallas	6′	6′ 3"	4	Simple condensing	14" x 16"
6	Aug. Demorest	6′	6′ 6"	4	Simple condensing	14" x 15"
7	Wm. Baxter	Two 4½′	4′ 6"	3	Compound	7" 14" x 14"
8	Wm. Spencer	8′	6′ 6"	4	Simple condensing	14" x 16"
9	A. J. Wright	8′	6′ 6"	4	Simple condensing	14" x 16"
10	Stranger	6′	6′ 6"	4	Simple condensing	12" x 16"
11	Walston	5′ 10"	6′ 6"	4	Compound	10" 18" x 14"
12	Wm. E. Cleary	6′	6′ 3"	4	Simple condensing	14" x 16"
13	Ridgway	6′	6′ 3"	4	Simple condensing	12" x 16"
14	City of Milwaukee	5′ 8"	6′ 0"	4	Compound	4¾" 4¾ x 14" 14
15	James W. Morse	6′	6′ 3"	4	Simple condensing	14" x 16"
16	Geo. W. Dimmers	6′	7′ 6"	4	Simple condensing	16" x 16"
17	Zenobia	6′	6′ 3"	4	Simple condensing	12" x 16"
18	Alfred Morgan	6′	6′ 6"	4	Simple condensing	14" x 16"
19	Arthur D. Bissell	8′	6′ 6"	4	Simple condensing	12" x 16"
20	E. P. Cooke	8′	6′ 3"	4	Simple condensing	12" x 16"
21	Dr. A. C. Hallarn	8′	6′ 0"	4	Simple condensing	12" x 16"
22	Francis B. Thurber	8′	6′ 0"	4	Simple condensing	12" x 16"
23	John Lang	6′	6′ 9"	4	Simple condensing	14" x 14"
24	Mahar & Burns	6′	6′ 6"	4	Simple condensing	14′ x 16"
25	Robert Rogers	6′	6′ 3"	4	Simple condensing	14" x 16"
26	H. C. French	6′	6′ 6"	4	Simple condensing	14" x 16"
27	C. H. Dimmers	6′	6′ 3"	4	Simple condensing	14" x 16"
28	G. R. Green	6′	6′ 3"	4	Simple condensing	14" x 16"
29	J. C. Austin	......	......	....	Simple condensing	12" x 16"

In order to secure exact data as to the performance of the canal, I detailed Mr. Aug. S. Kibbe, C. E., to make personal these boats and obtained a large amount of very interesting from which are given in an appendix. He was assisted in this servations are given in Table B herewith:

boats navigating the Erie canal, 1891 — (Concluded).

ENGINE.	NUMBER OF BUFFALO CLEARANCES.				
Built by —	1887.	1888.	1889.	1890.	1891.
G. W. Hall	....	...	......	......	5
G. W. Hall	...	......	2	5	5
G. W. Hall	...	......	2	7	6
Henry G. Trout	......	......	......	6	6
G. W. Hall	.	......	......	5	4
Pound Manufacturing Co	......	......	5	6	6
Fishkill Landing Machine Co	4	1	2	2	0
A. O. Whitmore	7	5	5	5	6
G. W. Hall	8	6	5	5	6
Pound Manufacturing Co	5	5	4	5	5
Henry G. Trout	5	6	5	6	7
G. W. Hall	3	5	4	5	6
G. W Hall	6	6	4	3	4
Utica Steam Engine Co	5	4	6	0	5
G. W. Hall	......	5	5	6	6
Pound Manufacturing Co	......	....	......	...	5
G. W. Hall	1	4	2	2	6
G. W. Hall	6	6	5	7	6
G. W. Hall	5	4	4	6	5
G. W. Hall	......	6	6	5	6
G. W. Hall	......	......	......	......	....
Pound Manufacturing Co	......	5	5	5	6
Trout Engine Co	5	3	4	5	2
G. W. Hall	1	7	5	7	5
G. W. Hall	7	7	6	6	7
G. W. Hall	......	5	6	5	6
A. O. Whitmore	5	3	6	6	5
G. W. Hall	.....	6	5	4	5
G. W. Hall	6	6	5	5	6

steam canal boats now engaged in transportation upon the Erie
observations upon this subject. He traveled upon a number of
information, which he has embodied in a report, extensive extracts
duty by Mr. Carleton Greene, C. E. Certain results of these

TABLE

RESULTS OF OBSERVATIONS UPON STEAM CANAL BOATS,

BOATS BOUND WEST

1.	2.	3.	4.	5.	SPEED.		8.	9.	10.
Number.	NAME.	From	To	Number of boats in fleet.	6. Observed, over-ground, miles per hour.	7. Estim'td, through water, miles per hour.	Cut-off inches of stroke.	Volume of steam used per stroke, cubic in.	Measure of expansion.
1	Acme	Newark	Lock 60	4	2.75	2.99	3.5	654	3.94
		Lock 61	Lock 62		2.59	2.88	3.7	685	3.76
		Lock 62	Lock 63		....	....	3.3	622	4.14
		Lock 66	Bridge 90		2.64	3.01	3.75	691	3.71
		Bridge 90	Bridge 102		2.51	2.88	4.1	746	3.45
		Bridge 104	Bridge 108		2.25	2.62	3.6	668	3.85
		Bridge 108	Bridge 119		2.53	2.90	4.0	730	3.58
		Bridge 119	Bridge 130		2.66	3.03	4.05	738	3.49
		Bridge 130	Bridge 136		2.25	2.62	3.3	622	4.14
		Bridge 136	Bridge 146		2.61	2.98	4.0	730	3.53
		Bridge 146	Bridge 154		2.78	3.15	4.0	730	3.53
		Bridge 154	Bridge 159		3.05	3.42	4.0	730	3.53
		Newark	Lockport		2.54	2.86	....	....	.....
2	A. J. Wright	Durhamville	Kirkville	3	2.78	2.48	4.5	806	3.19
3	Aug. Demarest	Gere's lock	Jordan	4	2.48	2.60	3.5	632	4.05
		Jordan	Port Byron		2.76	2.64	3.9	698	3.69
		Gere's lock	Port Byron		2.56	2.60	....	....	.....
4	Geo. W. Dimmers	Bridge 75, E. D.	Port Jackson	4	2.29	2.59	2.5	623	5.36
5	John B. Dallas	Spencerport	Albion	3	2.86	3.23	3.0	576	4.47
6	Lizzie Crandall	Rome	Higginsville	4	3.27	2.97	2.5	498	5.15
		Higginsville	Canastota		3.20	2.90	2.5	498	5.15
		Canastota	Chittenango		3.29	2.99	2.7	529	4.86
		Chittenango	Syracuse		3.27	2.97	2.5	498	5.15
		Rome	Syracuse		3.26	2.96	....	....	.....
7	Stranger	Jordan	Port Byron	3	2.69	2.57	4.0	520	3.61
8	Walston	Brockport	Albion	4	2.45	2.82	4.8	500	10.22
9	Wm. E. Cleary	Durhamville	New Boston	4	2.84	2.54	4.0	730	3.53
		New Boston	Manlius		2.86	2.56	4.1	746	3.45
		Manlius	Syracuse		2.85	2.55	4.0	730	3.58
		Durhamville	Syracuse		2.86	2.56	4.0	730	3.58

BOATS BOUND EAST

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
10	Carrie Stewart	Spencerport	Rochester	4	2.65	2.28	5.6	660	7.74
		Lock 63	Lock 62		2.62	2.38	5.1	520	9.83
		Lock 62	Macedon		2.49	2.25	4.8	520	10.22
		Macedon	Newark		2.40	2.16	4.4	500	11.11
		Lyons	Lock Berlin		2.17	1.93	4.8	460	10.22
		Lock Berlin	Clyde		2.41	2.17	4.8	500	10.22
		Clyde	Port Byron		2.12	1.98	4.8	500	10.22
		Port Byron	Jordan		1.85	1.99	4.8	500	10.22
		Jordan	Memphis		1.69	1.55	4.8	500	10.22
		Spencerport	Memphis		2.24	2.04	4.8	500	10.22
11	City of Milwaukee	Syracuse	Manlius	3	1.83	2.13	1.0	?	?
12	Columbia	Durhamville	Happy Val. rd.	5	1.86	2.16	5.0	985	2.91
		Happy Val. road	Bridge 45		1.82	2.12	5.0	985	2.91
		Bridge 45	Rome		1.83	2.13	5.0	985	2.91
		Rome	Murphy's road		1,98	1.68	5.0	985	2.91
		Durhamville	Utica		1.89	1.88	5.0	985	2.91
13	James W. Morse	Jordan	Newport	4	1.63	1.51	3.5	654	3.94
		Clute's farm br.	Lock 18		2.46	2.16	3.5	654	3.94
		Albany	Newburgh		3.21	?	3.5	654	3.94
14	Ridgway	Syracuse	Manlius	4	1.82	2.12	4.0	536	3.53
15	William Spencer	Syracuse	Kirkville	3	1.79	2.09	4.0	730	3.53

B.

ON THE ERIE CANAL, OCTOBER AND NOVEMBER, 1891.

WITH HALF CARGOES.

11.	12.	13.	14.	15.	16.	COAL.			20.		21.	
						17.	18.	19.				
Ratio, mean to initial pressure, above zero. Pounds.	Boiler pressure by gauge. Pounds per square inch.	Vacuum by gauge Inches.	Mean resultant pressure. Pounds per square inch.	Number of revolutions per minute.	Theoretical indicated horse power.	Per I. H. P per hour. Pounds.	Per boat per mile through water. Pounds.	Per boat per mile, estimated by master. Pounds.	Pitch of screw, as stated.		Slip of screw. Per cent.	Remarks.
									Ft.	In		
0.601	87	22	56.22	110	76.77	..	....	....	6	9	65	The Acme probably failed to do herself justice. Her shaft was slightly bent, her fire clinkered badly, and high head winds prevailed during the first day.
0.618	84	21	55.88	110	76.30	....	....	....	6	9	66	
0.585	85	21	53.00	100	65.79	....	....	....	6	9	....	
0.622	88	21	58.57	113	82.16	....	....	....	6	9	67	
0.648	82	23	58.55	114	82.86	....	....	....	6	9	70	
0.609	76	22	50.51	104	65.21	....	....	....	6	9	66	
0.641	83	21	57.22	114	80.97	....	....	....	6	9	67	
0.645	82.5	21	57.39	116	82.28	....	....	....	6	9	66	
0.585	64	23	40.93	92	46.71	....	....	....	6	9	63	
0.641	84	22	51.36	112	81.14	....	....	....	6	9	65	
0.641	82	23	57.58	114	81.48	....	....	....	6	9	64	
0.641	87	23	60.78	117	88.29	....	....	....	6	9	62	
.....	....	....	......	....	75.42	3.3	22.7	18 0	6	9	66	
0.678	68	18	49.27	90	55.04	3.0?	20.4	22.0	6	6	63	The screw is of the "dishpan" type.
0.592	87	24	57.12	108	76 58	....	....	....	6	6	68	
0.625	87	24	59.56	112	82.81	....	..	....	6	6	68	
.....	....	....	......	....	......	2.9	20.6	18.5	6	6	68	
0.500	110	15	54.00	120	105.4	?	?	20.0	7	6?	75	Pitch of screw probably stated too large.
0.559	111	21	64 93	103	60.96	3.4	·19.0	20.0	6	3	56	
0.512	98	24	53.65	122	81.25	....	....	....	6	2	65	
0.512	101	24	55.16	123	84.22	....	....	....	6	2	67	
0.531	104	23	58.82	127	92.73	....	....	....	6	2	67	
0.512	100	24	54.65	124	84.12	....	....	....	6	2	65	
.....	....	....	... ..	....	......	2.4	17.6	17.0	6	2	66	
0.632	117	21	77.92	100	71.04	3.??	27.9	22.7	6	6	65	
0.325	127	9	34.65	108	67.36	2.2	13.2	16.0	6	6	65	
0.641	88	22	60.17	102	76.19	....	....	....	6	3	65	
0.648	90	21	62.75	102	79.45	....	....	....	6	3	65	
0.641	88	22	60.92	100	75.62	....	....	....	6	3	64	
0.641	88	22	......	101	......	?	?	20.0	6	3	65	

WITH FULL CARGOES.

11.	12.	13.	14.	15.	16.	17.	18.	19.	20. Ft.	20. In	21.	Remarks.
0.393	132	12	47.77	122	104.90	1.8	....	....	6	9	76	Shaft out of line, engine pounding somewhat and bearings inclined to heat.
0.334	137	11	40.27	120	93.51	....	....	....	6	9	76	
0.325	130	12	37.13	124	82.88	2.7	....	....	6	9	76	
0.306	132	12	34.98	122	76.83	2.2	....	....	6	9	77	
0.325	133	11	37.60	123	83.26	....	....	....	6	9	80	
0.325	135	11	38.25	128	88.13	....	....	....	6	9	78	
0.325	132	10	36.78	109	72 16	2.9	....	....	6	9	76	
0.325	133	9	36.60	107	70.50	3.1	....	....	6	9	76	
0.325	134	8	36.93	108	71.80	2.7	....	....	6	9	81	
0.325	133	11	37.60	120	81.23	2.2	20.2	19.0	6	9	77	
?	95	?	?	77	?	?	?	22.0	6	0	59	
0.710	76	20	58.61	96	69.84	....	....	....	6	4	69	Temporary screw
0.710	74	21	57.69	95	68.08	....	....	....	6	4	69	
0.710	76	19	58.01	96	69.12	....	....	....	6	4	69	
0.710	75	16	55.90	94	65.23	....	....	....	6	4	75	
0.710	....	....	......	....	......	?	?	16.7	6	4	73	
0.601	86	19	54.45	89	60.15	3.0	30.7	18.0	6	3	76	
0.601	83	21	......	97	68.57	2.7	....	....	6	3	69	
0 601	83	24	55.90	91	61.86	2.7	?	....	6	3	?	
0.641	64	16	42.64	92	35.78	....	14.5	15.0	6	3	68	
0.641	66	21	46.42	72	41.47	....	17.6	18.7	6	6	61	The screw is of the "dishpan" type.

The steam fleets on the Erie canal at this time run at an average speed of two and one-half miles per hour through the water. The distance between Buffalo and Albany is 352 miles, and the trip is made, including ordinary detentions and lockages, in about seven and one-quarter days. The coal consumption averages about twenty and five-tenths pounds per boat per mile through the water. The fleet of steamer and three boats carries a crew of ten men, including the captain, six men being upon the steamer and its consort and four upon the boats towed. The following table gives the actual time-table of a steamer and its accompanying boats during the season of 1891. This steamer, Walston, is described in Table A, referred to above:

TRIPS OF STEAMER WALSTON WITH THREE BOATS, SEASON OF 1891.

TRIPS.		LEFT.		ARRIVED.		DAYS ELAPSED.		
West.	East.	New York.	Buffalo.	Buffalo.	New York	In travel.	At New York.	At Buffalo.
1	......	* May 7	....	May 16	....	9	....	3
......	1	....	May 19	....	May 27	8	8	....
2	...	June 4	....	June 13	....	9	....	†8
...	2	....	June 21	....	June 30	9	10	....
3	......	July 10	....	July 19	....	9	....	†16
......	3	....	August 4	....	August 13	9	6	....
4	......	August 19	....	August 29	....	10	....	3
......	4	....	Sept. 1	....	Sept. 10	9	5	....
5	......	Sept. 15	....	Sept. 24	....	9	....	5
......	5	....	Sept. 29	....	Oct. 9	10	6	....
6	......	Oct. 15	....	Oct. 24	....	9	....	4
......	6	....	Oct. 28	....	Nov. 6	9	5	....
7	......	Nov. 11	....	Nov. 20	....	9	....	....
......	7	....	Nov.	....	Dec.	‡		
Totals for thirteen trips						118	40	39
Averages						9 1-13	6⅔	6½

It will be seen that this boat, with its tow, made seven round-trips between Buffalo and New York, and out of 197 days navigation, 118 were spent in traveling and delays en route, forty days in New York discharging and loading cargo, and thirty-nine in Buffalo discharging and loading and in delays on account of breaks in canal. This shows, inclusive of everything, an average per round-trip of eighteen days four hours running and thirteen days four hours

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* Reported as leaving West Troy on this date and detained on canal.
† Laid at Buffalo to avoid crowd of boats at a break in the canal.
‡ Dates not reported. Caught in ice and broke a passage from Little Falls to West Troy.

in port, making thirty-one days eight hours per round-trip. All information secured goes to show that one round-trip per month may be accomplished by such a fleet under present practice and during the season of open canals, from May first to December first.

Some steamers do not continue in constant travel between Buffalo and New York throughout a season. The following record of the steamer Carrie Stewart, from March 12, 1891, to December 1, 1891, is of interest: This boat made six round-trips between New York and Buffalo, with either three or five consorts, and eleven trips to other points — New Haven, Bridgeport, Philadelphia and Baltimore — and ran over 7,300 miles in less than 270 days.

Trips of Steamer Carrie Stewart.

1891.

1. Steamer and consort, New York to Philadelphia.
2. Steamer and consort, Philadelphia to New Haven.
3. Steamer and consort, New Haven to New York.
4. Steamer and consort, New York to Philadelphia.
5. Steamer and consort, Philadelphia to New York.
6. Steamer and three consorts, New York to Buffalo.
7. Steamer and five consorts, Buffalo to New York.
8. Steamer and three consorts, New York to Buffalo.
9. Steamer and three consorts, Buffalo to New York.
10. Steamer alone, New York to Bridgeport.
11. Steamer alone, Bridgeport to New York.
12. Steamer alone, New York to Bridgeport.
13. Steamer alone, Bridgeport to New York.
14. Steamer and three consorts, New York to Buffalo.
15. Steamer and three consorts, Buffalo to New York.
16. Steamer and five consorts, New York to Buffalo.
17. Steamer and five consorts, Buffalo to New York.
18. Steamer and three consorts, New York to Buffalo.
19. Steamer and three consorts, Buffalo to New York.
20. Steamer and three consorts, New York to Buffalo.
21. Steamer and three consorts, Buffalo to New York.
22. Steamer and three consorts, New York to Baltimore.
23. Steamer and three consorts, Baltimore to New York.

Cost of Transportation on the Erie Canal.

I have secured data as to the actual cost of transportation upon the canals in 1891, both by the horse boats and by those propelled by steam. This has been obtained through interviews with many owners and captains of boats and by the actual observation of Assistant Engineer Kibbe. The wages of men employed on the horse boats are from twenty dollars to thirty-five dollars per month and board; the board costs about thirty cents per day, making the wages thirty dollars to forty-five dollars per month. The feed of six horses or mules costs about seventy-five dollars per month, and there must be allowed about ten dollars per month for shoes and medicine. In the tables of cost is included an item for incidentals, which provides for tow lines, oil for lights, etc. Wharfage in Buffalo is free; in New York there is a charge of thirty cents for each light boat and forty cents for each loaded boat at each dock touched. Fifty dollars per month has been charged for the captain's time and board. The estimate is made on the basis of 250 ton carrying capacity for each boat.

For the four boat steam fleets the steamer carries 180 tons and the consorts 250 tons each. The wages paid are, for wheelmen, one of whom acts as a river pilot, forty dollars and forty-five dollars per month and board; for deck hands, twenty-five dollars per month; for engineers, twenty-five dollars and fifty dollars per month, with board additional; for the captain of the tow, forty-five dollars per month, and for steersmen and deck hands, one dollar and fifty cents per day and board. The coal consumption per round trip, Buffalo to New York and return, is about thirty-six tons. On their return trip from New York to Buffalo the steamer carries an average of about 136 tons and the consorts from 140 to 150 tons of miscellaneous freight, the rates obtained varying from forty cents to one dollar and fifteen cents per ton from New York to Buffalo. The insurance on wheat carried from Buffalo to New York is invariably paid by the owner of the boat and for 8,000 bushels, valued at one dollar per bushel, is, for a first-class boat, twenty dollars; second class, twenty-five dollars; third class, thirty dollars. The following tables, prepared by Mr. Kibbe, give the cost in detail:

Cost of transportation on the Erie canal and the Hudson river, between Buffalo and New York, by boats carrying full cargoes of wheat easterly at four cents per bushel, and obtaining partial cargoes of merchandise returning at sixty cents per ton.

A. By double-header horse boats.
B. By four boat steam fleet.
C. By six boat steam fleet.

A. Double-header horse boats of 250 *tons capacity, each making either six or seven round trips.*

Investment:

Two first-class boats, of 250 tons capacity each, fitted up, ready for business	$7,000
Six horses or mules, at $150	900
Six sets of harness, at $12	72
Total	$7,972

Annual expenses:

Interest on investment at six per cent	$478
Reserve fund, to replace boats in fifteen years	284
Reserve fund, to replace stock in six years	122
Repairs, at five per cent, on $7,072	354
Insurance on boats	150
Wharfage for winter, light	28
Keep of stock for winter	155
Keep of stock during season of navigation, including feed, shoes and medicine, seven months, at $85	595
Fixed annual expenses	$2,166

If six trips be made per season, the running expenses would be:

Wages and board, captain and four crew, for season	$1,250
Incidental expenses	100
Towing on river, two boats, at $45 per boat, six trips	540

Commissions, five per cent on $4,000 freight	$200
Insurance on cargoes, six trips, at $20 per boat per trip	240
Wharfage, New York, six trips, at $5	30
	$2,360
Add fixed annual expenses	2,166
Total annual expenses	$4,526
Tons transported:	
East, 250 x 2 x 6 trips	3,000
West, 100 x 2 x 6 trips	1,200
Total tons	4,200
Cost per ton, Buffalo to New York, 495 miles	$1.077
Cost per ton per mile, mills	2.18
Cost per bushel wheat, 495 miles, cents	3.231
Trimming, Buffalo and New York, cents	.275
Cost to canaler, per bushel of wheat, Buffalo to New York, cents	3.506
Elevator charges, New York, per bushel, cents	1.125
Cost per bushel, moved 495 miles and transhipped at New York, cents	4.631

Season's account, six trips:

RECEIPTS.		
100,000 bushels wheat, at 4 cents	$4,000	
1,200 tons merchandise, at 60 cents	720	
		$4,720
EXPENDITURES.		
Annual cost of running	$4,526	
100,000 bushels wheat, trimmed, at .275 cents	275	
		$4,801
Net loss, six round trips		$81

If seven trips were made, the running expenses would be:

Wages and board, captain and four crew, seven months, at $200	$1,400	
Incidental expenses	100	
Towing on river, 2 boats, at $45 per boat, 7 trips	630	
Commissions, 5 per cent on $4,667 freight	233	
Insurance on cargoes, 7 trips at $20 per boat, per trip	280	
Wharfage, New York, 7 trips at $5	35	
		$2,678
Add fixed annual expenses		2,166
Total expenses per annum		$4,844

Tons transported:

East, 250 x 2 x 7	3,500
West, 100 x 2 x 7	1,400
Total tons	4,900

Cost per ton, Buffalo to New York, 495 miles, cents	98.09
Cost per ton mile, mills	1.982

Cost per bushel wheat, 495 miles, cents	2.942
Trimming, Buffalo to New York, cents	.275
Cost to canaler per bushel of wheat, cents	3.217
Elevator charges, New York, cents	1.125
Cost per bushel wheat, moved 495 miles and transshipped at New York, cents	4.342

Season's account, seven round trips:

RECEIPTS.

116,667 bushels wheat at 4 cents	$4,666 67	
1,400 tons merchandise at 60 cents	840 00	
	$5,506 67	$5,507

EXPENDITURES.

Annual cost of running	**$4,830**	
116,667 bushels wheat, trimmed, at .275 cents	**321**	
		$5,151
Net profit, 7 round trips		**$356**

B. Four boat steam fleet, one steamer and three boats of 250 *tons.*

Investment:

Steamer, bare, of 180 tons capacity	$7,200
Three consorts, of 250 tons capacity, each at $3,500	10,500
Fitting up for service	300
Total	$18,500

Annual expenses:

Interest on investment at six per cent	$1,110
Reserve fund to replace fleet in fifteen years	750
Repairs, five per cent	925
Insurance on steamer	150
Insurance on consorts	225
Wharfage for winter, light fleet	56
Fixed annual expenses	$3,216

Six round trips, running expenses:

Wages and board, captain and nine crew, seven months, at $426	$2,982	
Coal, thirty-six tons per round trip, at $4.25	918	
Oil and waste, at $7 per round trip	42	
Insurance on cargoes, $80 per round trip	480	
Commissions, five per cent on $7,440 freight	372	
Wharfage and incidentals, say	186	
		4,980
Total annual expenses		$8,196

Tons transported:

East (180+250 x 3) x 6	5,580
West (136+150+140 x 2) x 6	3,396
	8,976

Cost per ton, Buffalo to New York, 495 miles	$0.9131
Cost per ton mile, mills	1.845
Cost per bushel of wheat, Buffalo to New York, cents	2.739
Trimming per bushel, Buffalo and New York, cents	0.275
Cost per bushel borne by steam canaler, cents	3.014
Elevator charges, New York, per bushel, cents	1.125
Total cost, per bushel, loaded in Buffalo and transshipped in New York, cents	4.139

Season's account, six round trips:

Assuming that the steamer does all towing for fleet in New York and Buffalo.

RECEIPTS.

186,000 bushels wheat, at 4 cents	$7,440
3,396 tons merchandise at 60 cents	2,038
Towing charges, Buffalo, $8 x 4 x 6	192
Towing charges, New York, $14 x 4 x 6	336
	$10,006

EXPENDITURES.

Cost of running fleet	$8,196	
186,000 bushels trimmed, at 0.275 cents	512	
		8,708
Net profit, six round trips		$1,298

Running expenses, seven round trips:

Wages and board, captain and nine crew, seven months, at $426	$2,982
Coal, 36 tons per round trip, at $4.25	1,071
Oil and waste, at $7 per round trip	49

Insurance on cargoes, $80 per round trip	$560
Commissions, 5 per cent on $8,680 freight	434
Wharfage and incidentals	214
	$5,310
Add fixed annual expenses	3,216
Total annual expenses	$8,526
Tons transported:	
East (180 + 250 x 3) x 7	6,510
West (136 + 150 + 140 x 2) x 7	3,962
	10,472
Cost per ton, Buffalo to New York, 495 miles	$0.8142
Cost per ton mile, mills	1.64
Cost per bushel of wheat, Buffalo to New York, cents	2.443
Trimming, per bushel, Buffalo to New York, cents	0.275
Cost, per bushel borne by steam canalers, cents	2.718
Elevator charges, New York, per bushel, cents	1.125
Total cost per bushel, loaded in Buffalo and transshipped to New York, cents	3.843

Season's account, seven round trips:

RECEIPTS.		
217,000 bushels wheat, at 4 cents	$8,680	
3,962 tons merchandise, at 60 cents	2,377	
Towing charges, Buffalo, $8 x 4 x 7	224	
Towing charges, New York, $14 x 4 x 7	392	
		$11,673
EXPENDITURES.		
Cost of running fleet	$8,526	
Two hundred and seventeen thousand bushels trimmed, at 0.275 cents	597	
		9,123
Net profit, seven round trips		$2,550

C. Six boat steam fleet; one steamer and five boats of 240 *tons.*

Investment:		
Steamer, bare, of 180 tons capacity		$7,200
Five consorts of 240 tons each at $3,200		16,000
Fitting up for service		800
Total		$24,000
Annual expenses:		
Interest on investment at six per cent		$1,440
Reserve fund to replace fleet in fifteen years		973
Repairs, five per cent		1,200
Insurance on steamer		150
Insurances on consorts		375
Wharfage for winter, light fleet, say		82
Fixed annual expenses		$4,220
Five round trips, running expenses:		
Wages and board, captain and eleven crew, seven months at $595	$4,165	
Coal, fifty tons per round trip at four dollars and twenty-five cents	1.063	
Oil and waste, five round trips, at seven dollars	35	
Insurance on cargoes, $120 per round trip	600	
Commissions, five per cent on freight, $9,200,	460	
Wharfage and incidentals, say	257	
		6,580
Total annual expense		$10,800
Tons transported:		
East (180 + 240 x 5) x 5	6,900	
West (140 + 170 + 1 (x 4) x 5	4,550	
		11,450

Cost per ton, Buffalo to New York, 495 miles	$0.94323
Cost per ton mile, mills	1.906

Cost per bushel of wheat, Buffalo to New York, cents	2.830
Trimming, per bushel, Buffalo and New York, cents	0.275
Cost per bushel, borne by steam canaler, cents	3.105
Elevator charge, New York, per bushel, cents	1.125
Total cost per bushel, loaded in Buffalo and transshipped in New York, cents	4.230

Season's account, five round trips:

On same assumptions as for four boat steam fleet:

RECEIPTS.

230,000 bushels wheat at four cents		$9,200
4,550 tons merchandise at sixty cents		2,730
Towing charges, Buffalo $8 x 6 x 5		240
Towing charges, New York $14 x 6 x 5		420
		$12,590

EXPENDITURES.

Cost of running fleet	$10,800	
230,000 bushels trimmed at 0.275 cents	633	
		11,433
Net profit, five round trips		$1,157

Running expenses, six round trips:

Wages and board, captain and eleven men, seven months, at $595	$4,165
Coal, fifty tons per round trip, at $4.25	1,275
Oil and waste, at $7 per round trip	42
Insurance on cargoes, $120 per round trip	720
Commissions, five per cent on $11,040, freight	552
Wharfage and incidentals	296
	$7,050
Add fixed expenses	4,220
Total annual expense	$11,270

Tons transported:

East (180 + 240 x 5) x 6	8,280
West (140 + 170+150 x 4) x 6	5,460
	13,740

Cost per ton, Buffalo to New York, 495 miles	$0.8202
Cost per ton mile, mills	1.66

Cost per bushel of wheat, Buffalo to New York, cents	2.561
Trimming, per bushel, Buffalo and New York, cents	.275
Cost, per bushel, borne by canaler, cents	2.836
Elevator charges, New York, cents	1.125
Total cost per bushel loaded in Buffalo and transshipped in New York, cents	3.961

Season's account, six round trips:

RECEIPTS.		
276,000 bushels wheat, at four cents	$11,040	
5,460 tons merchandise, at sixty cents	3,276	
Towing charges, Buffalo, $8 x 6 x 6	288	
Towing charges, New York, $14 x 6 x 6	504	
		$15,110
EXPENDITURES.		
Cost of running fleet	$11,270	
276,000 bushels trimmed, at .275 cents	759	
		12,029
Net profit, six round trips		$3,081

The above results are summarized in the following table, and the succeeding table shows the estimated net profit or loss entailed by various rates on wheat, from 2.5 to 4.5 cents.

ESTIMATED COST OF FREIGHT TRANSPORTATION BETWEEN BUFFALO AND NEW YORK, VIA ERIE CANAL AND HUDSON RIVER, 1891, WITH ESTIMATED SEASON'S ACCOUNTS.

Number.	MODE OF TRANSPORTATION.	Investment.	Fixed annual expenses.	Number of round trips.	Running expenses.	Total expenses per annum.	Tons transported.	COST.					TOTAL ANNUAL		NET	
								Per ton between Buffalo and New York.	Per ton per mile.	Per bushel of wheat, Buffalo to New York.	Per bushel of wheat borne by canaler.	Per bushel of wheat, loaded in Buffalo, carried to and transshipped at New York.	Receipts, with four cent grain rate and sixty-cent ton return.	Expenditures.	Profit.	Loss.
								Cents.	Mills.	Cents.	Cents.	Cents.				
1	Double-header horse-boats	$7,972	$2,166	6	$2,360	$4,526	4,200	107.70	2.18	3.231	3.506	4.631	$4,720	$4,801	......	$81
2	Double-header horse-boats	7,972	2,166	7	2,678	4,844	4,900	98.09	1.98	2.942	3.217	4.342	5,507	5,151	$356	.....
3	Four-boat steam fleets.........	18,500	3,216	6	4,980	8,196	8,976	91.31	1.85	2.739	3.014	4.139	10,006	8,708	1,298	.....
4	Four-boat steam fleets.........	18,500	3,216	7	5,310	8,526	10,472	81.42	1.64	2.443	2.718	3.843	11,673	9,123	2,550	.....
5	Six-boat steam fleets	24,000	4,220	5	6,580	10,800	11,450	94.32	1.91	2.830	3.105	4.230	12,590	11,433	1,157	.....
6	Six-boat steam fleets	24,000	4,220	6	7,050	11,270	13,740	82.02	1.66	2.561	2.836	3.961	15,110	12,029	3,081	.....

ESTIMATED PROFITS OR LOSSES PER SEASON ENTAILED IN TRANSPORTATION ON ABOVE BASIS, BY VARIOUS RATES OF FREIGHT ON WHEAT.

Number.	MODE OF TRANSPORTATION.	Number of trips.	RATE PER BUSHEL, BUFFALO TO NEW YORK.										
			2.5 CENTS.*		3.0 CENTS.		3.5 CENTS.		4.0 CENTS.		4.5 CENTS.		DIFFERENCE OF 0.5 CENTS.
			Profit.	Loss.	Profit.	Loss.	Profit.	Loss.	Profit.	Loss.	Profit.	Loss.	Difference of profit.
1	Double-header horse-boats	6	......	$1,506	......	$1,081	....	$556	....	$81	$394	......	$475.0
2	Double-header horse-boats	7	......	1,306	......	752	....	198	$356	......	910	......	554.0
3	Four-boat steam fleet	6	......	1,358	......	474	$410	......	1,298	......	2,178	......	883.5
4	Four-boat steam fleet	7	......	543	$488	....	1.519	......	2.550	......	3,581	......	1,031.3
5	Six-boat steam fleet	5	......	2,122	......	1,029	64	......	1,157	......	2,251	......	1,093.5
6	Six-boat steam fleet	6	......	852	459	....	1,770	......	3,081	......	4,392	......	1,311.0

The following are the average rates per bushels by months, paid on wheat from Buffalo to New York during the season of 1891:

May, cents	2.51
June, cents	2.53
July, cents	2.68
August, cents	3.94
September, cents	4.19
October, cents	4.44
November, cents	4.13
Average for season, cents	3.49

The average rate is therefore about three and one-half cents per bushel, and it will be seen that horse boats running in couples really lose money, even when making seven trips. This of course means that the owners of these boats, who are very often their captains, do not lay aside the amount indicated in the tables above as necessary for a reserve fund to replace the boats when they shall become useless, or the amount requisite for proper repairs. Many of these owners and captains do not appreciate this feature of the case, but there is no doubt that it is correct. It will be seen, however, that a four-boat steam fleet gives a much more favorable result. It will also be seen that the difference in the possible profit between making six trips or seven is very great and that if it were practicable to prevent the delays which now occur, or to lengthen the season of navigation, or to increase the speed of the boats the results would be favorable to profitable canal transportation. The policy of the State of New York has been generally to foster the interests which depend upon the maintenance of the canals in good condition. This policy has, without doubt, done much to increase and maintain the commerce of the port of New York. The maintenance of the canals has also certainly regulated railroad rates from the West to the seaboard and prevented excessive increase of such rates. The amount of grain transported upon the canal is not of so much consequence in this direction as the fact that the canal is in existence and in condition to transport grain at moderate rates, in connection with lake vessels. The tolls formerly charged for canal traffic were abolished in 1882. Since that time the canals have been maintained and improved, the dimensions of the locks increased, and the structures and banks kept in repair by the State, without charge to transportation interests. The length of the season of navigation has recently been generally made seven months, May first to December first. The actual closing of the canals is often somewhat later than December first, the State aiding as far as possible, with the State boats and when necessary with ice breakers, any boats which have started with their cargoes, and which have been caught in the ice. It is probable that the canals might be opened somewhat earlier than May first, although the banks are apt to be in better condition when left to free themselves thoroughly from frost during the month of April.

The policy adopted and continued during the past few years, of lengthening the locks in the Erie canal so as to admit the passage of double-header boats without uncoupling, certainly aids in reducing the time and cost of transportation. A thorough cleaning of the channel so that the full depth of seven feet shall be secured at every point, is also of the greatest advantage.

As stated above, a moderate increase of the depth of water of the Erie canal has been advocated so as to make it eight feet instead of seven feet. The estimated cost of this improvement was $1,150,000; this contemplated raising the banks and not excavating the bottom of the canal. The advantage to transportation was ably discussed by Hon. Elnathan Sweet, my predecessor, with the conclusion that such an increase of depth of one foot would shorten the trip from Buffalo to West Troy nearly twelve hours, by reducing the resistance to the passage of the boats.

My predecessor also presented in a remarkably able paper, an outline of a plan for securing a ship canal from Lake Erie to the Hudson river, and in that paper and in the discussion following it, also referred to in a former page of this report, this whole subject was fully considered. The canal proposed was one of eighteen feet depth of water, 100 feet wide at bottom, with locks 450 feet long and sixty feet wide. It was proposed that it should receive its water from Lake Erie and discharge it into the Hudson, thus not depending for water supply upon any territory through which it passed. No detailed estimate was made of the cost of such a canal, but it was roughly assumed at from $125,000,000 to $150,000,000. It is not intended, in this report, to discuss the question of the construction of such a ship canal, although I believe that such construction is entirely feasible.

Very recent developments of the economical transmission of power by electricity, suggest the possibility of its application in some form to the State canals. This possibility, and the improvements that may be fairly expected in steam propulsion, will reduce the actual cost of transportation between Buffalo and tide-water to as low a rate as can be expected, with such a waterway as now exists. If the State continues to maintain this waterway, certain improvements which have been suggested in former reports, by myself and other State Engineers, should be made, particularly in securing and maintaining the full depth of water and in the improvement of alignment at certain points. This is particularly necessary, because the double-header system and the tows of the steamer demand for proper progress, curves of longer radii than were required by the former single boats.

The Belgian System on the Erie Canal.

In 1872, under authorization of a concurrent resolution of the Legislature, the New York Steam Cable Towing Company laid a cable upon the bottom of the canal between Buffalo and Lockport and put in operation, in 1873, two cable tugs, provided with the towing machinery ordinarily used with what is called the Belgian system. The cable was afterwards extended from Lockport to Rochester and additional boats put in service. Much complaint was made by the owners and operators of other boats upon the canal that the Belgian boats caused frequent delays to navigation, injury to other boats and injury to the banks and walls of the canal. In 1880 the Superintendent of Public Works reported that he had caused careful examinations to be made of the practical operations of the cable system, and that it was impracticable and unadvisable upon the Erie canal. The system was abandoned and the cable finally taken away.

Towing on the Hudson River.

While the steam canal boat takes its own fleet of three other boats from Albany to New York, on the Hudson river, the boats which are propelled by horses on the Erie canal are towed from Albany to New York and return, in large fleets, and generally by regular lines of towing steamers. The fleet of boats is made up at Albany, with four or five boats abreast and from five to twenty-five boats long, the whole secured together by hawsers into a compact mass of from twenty to 115 boats. The towing steamer, in the case of large tows, runs from 600 to 720 feet in advance, and uses, generally, three hawsers, six and one-half inches in circumference, running to the outside and middle of the fleet of boats. The towing boats were, up to a recent date, usually side-wheels steamers, but within a few years screw-propellers have been introduced, apparently with success. The largest of these boats are 120 feet long, twenty-six feet wide, draw eleven feet of water, have compound engines, and cost about $50,000. These boats consume about ninety-six hours in the round trip, and average about fifty boats to a tow. The charges for towing a canal boat between Albany and New York are twenty-five dollars per trip, loaded, and fifteen dollars light.

Towing on the Illinois and Michigan Canal.

Noting that the traffic upon the Illinois and Michigan canal was, in some respects, similar to that upon the Erie, I directed Mr. Kibbe to visit Chicago and secure such information as might be available as to the methods in use on that canal. Extracts from his report are given in an appendix.

The Illinois and Michigan canal runs from Lake Michigan, at Chicago, to the Illinois river, at La Salle, about 102 miles. It has a depth of six feet of water; is sixty feet wide at the surface, with a bottom width in earth of forty-eight and in rock of sixty feet. A large portion of the sewage of the city of Chicago is sent through this canal. In order to increase the flow so as to take care of this sewage a guard-lock has been built near Chicago, and eight large centrifugal pumps, with a combined capacity of 60,000 cubic feet per minute are in operation, and the elevation of the water in the canal beyond the guard-lock is raised five feet above the surface of the lake. In spite of the rapid current produced there is a constant deposit of material requiring dredging. The structures on this canal are similar to those on the Erie. A large amount of stone is carried from Joliet to Chicago; the total freight transported upon the whole canal during 1890 being about 750,000 tons. The motive power is steam. The boats are well built, 104 feet long, seventeen feet nine inches wide on deck, but reduced to fourteen feet ten inches at the bottom to correspond with the shape of the lock chambers. The steamers carry cargo of about 140 tons and the other boats about 156 tons, with a draft of water of four feet eight inches. The fleets are made up of four boats, a steamer pushing one consort and towing two; the two towed boats not being coupled together, but separated from two to three hundred feet.

Coal Towage on the Ohio River.

Some information has also been secured and is given in detail in the appendix upon the mode of transportation of coal on the Ohio river. This coal comes from the mines on the Allegheny, Monongahela and Youghiogheny rivers and is brought to Pittsburg in boats which are there made into tows. The navigation of the Monongahela is a slack water navigation with dams and locks connected. There was brought through these locks in 1890 4,652,000 tons of coal. Below Pittsburg the navigation is continuous in the Ohio and the Mississippi, with the exception of a dam at Davis Island, near Pittsburg, and the falls at Louisville. At the Davis Island dam the connecting lock is used at low stages of the river, but at other times the boats pass directly over the dam. At Louisville the canal around the falls is used as the depth of water over the falls is not sufficient for the boats to pass directly over them.

The coal which is sent from Pittsburg is carried in either coal boats, barges, fuel boats or flats. The coal boats are rectangular boxes of hemlock one and one-half inches thick, and they are made about 175 feet long, twenty-six feet wide and nine to ten feet deep. When loaded they draw about seven and one-half feet of water and will hold about 25,000 bushels or 1,000 tons of coal. They cost about $650. They carry coal from Pittsburg to points below Louisville, are sold with the coal and are broken up and used by the planters along the Mississippi river. Some, sold to the coal trade in New Orleans, are towed back at a nominal price, about seventy-five dollars, and are brought back to Pittsburg and used again, but never for more than three trips. Of about 1,500 sent out of Pittsburg annually not more than 250 are returned.

The coal barge is more substantial, built of six inch pine, is modeled similarly to canal boats; 130 to 135 feet long, twenty-six feet wide and seven and five-tenths to eight feet deep. They carry 13,000 to 15,000 bushels of coal and cost $1,200 to $1,400. They carry coal to Cincinnati, Louisville and St. Louis and are in service about twelve years.

Fuel boats are similar to barges but not so large, carrying about 7,000 bushels; costing between $600 and $700; with a life of ten years; they carry the fuel of the towing steamers. "Flats" are still smaller, carrying about 4,000 bushels.

The steamers which do the towing are of various sizes, the smaller ones being engaged above Pittsburg, others between Pittsburg and Louisville, and the larger ones between Louisville and New Orleans. They are all stern-wheelers of light draft, with double engines of high pressure. They have a pair of exhaust-pipes from the engine to the paddle wheels at the stern, the exhaust steam, when required, being used to prevent the formation of ice on the wheel. The fleet of boats is made up at Safe Harbor below Pittsburg, generally three abreast with two at the rear, the steamer's bow coming in about twenty feet between the two stern boats. The fuel boats are fastened at the sides of the two stern boats and the whole fleet bound together with large cables. They are then pushed down the river with the steamer astern, making the run from Pittsburg to Louisville, about 600 miles, in about four days; thence to Cairo, about 400 miles, in three days; from Cairo to New Orleans, 970 miles, in about sixteen days. Up stream, with tows, the steamers run about four miles per hour, and without tows, run nine to ten miles per hour.

The cost of transportation of coal from Pittsburg to New Orleans is about one dollar per ton, or about 0.51 mills per ton mile.

Supervising Commissioners of the Capitol.

The State Engineer has been, for two years past, in accordance with the statute, associated with the Lieutenant-Governor and the Commissioner of the New Capitol in the direction of the very large amount of work which has been in progress upon that structure. Very satisfactory results have been secured in the construction of the great eastern approach, the western staircase and the progress to completion of various parts of the building.

The Commission to Supervise the Repairs and Improvements of the Quarantine Establishment of the Port of New York.

The State Engineer is, ex-officio, a member of this commission and has been actively interested in the very necessary work of repair of the structures on the islands in the lower bay and the boarding station at Staten Island, all of which were, before the establishment of this special commission, in a very dilapidated condition.

The Commissioners of the Land Office.

The engineering duties connected with the work of the Commissioners of the Land Office are intrusted to a bureau of this department, which is under the immediate control of the State Engineer personally, who has been assisted by Henry C. Parsons, C. E. All applications for grants of land under water, for State lands or for mineral grants are referred to the State Engineer, with reference to all points connected with surveys and descriptions. Frequent visits have to be made to various localities and reports are presented at each monthly meeting of the commission. The State Engineer is also intrusted with the public sales of State lands, of which there have been during the past year 379 parcels, realizing from the sale $24,338.20.

Appraisal of County Lands.

During the year visits have been made, with the State Comptroller and the President of the State Board of Charities to certain county asylums for the insane, for the purpose of appraising the real estate and buildings of those asylums, in accordance with a special statute creating this commission.

The Canals in 1891.

The State canals were closed on the 1st of December, 1890, except that boats on the eastern division were allowed to endeavor to reach tide-water, but on the third of December, forty boats were frozen in between Amsterdam and Schenectady.

On the 5th of May, 1891, all the canals were opened to navigation.

During the winter the work of doubling the length of one of each of the twin locks, Nos. 40, 41, 42, 43 and 46. on the Erie canal and of the single locks, Nos. 8 and 12, of the Oswego canal was completed. Lock No. 1, of the Black River canal was rebuilt.

On the Champlain canal, improvement work was completed at the following points:

One mile south of Mechanicville, culvert No. 7 was rebuilt. Through Mechanicville, 0.74 miles of canal were deepened and widened. North of the waste-weir at Mechanicville, 0.27 miles of canal were deepened and widened. One mile north of Mechanicville, 0.34 miles of canal were deepened and widened. One mile north of Smith's Basin, 0.29 miles of canal were deepened and widened. South of Whitehall, 0.10 miles of canal were deepened and widened.

These improvements make a total of 1.74 miles of enlarged canal.

The Legislature, having made no appropriation for canal improvement at the last session, the general statement of improvement completed, remains substantially the same as in the report of last year. It is to be regretted that the work of improving the Champlain canal is stopped, as the full benefit of deepening and widening can not be felt in navigation until the whole canal is improved and only sixteen miles have been deepened to six feet since this improvement was begun in 1885. There remain over forty miles of this canal with but five feet depth of water and with the old tortuous alignment.

The improvement of this canal is demanded by the increasing business on this important channel of trade.

The only important work of canal improvement that can go on this winter, will be 0.61 miles of the Champlain canal improvement, about two miles north of Bemis Heights, which work was not awarded last fall on account of informality in the bid.

The Black River canal is left with twenty locks, requiring rebuilding at once, otherwise it will not be possible to keep the canal open much longer and the water from the Black River canal is needed for the Rome level of the Erie canal.

On the middle division of the Erie canal there still remain 10.44 miles of old bench walls which should be removed to bring the canal up to standard efficiency.

In 1882, the following estimate was made for this work, which remains in the same condition:

Frankfort level, 22 chains bench walls............	$4,000 00
Rome level, 327 chains bench walls...............	60,000 00
Syracuse level, 32 chains bench walls..............	13,000 00
Jordan level, 454 chains bench walls.............	75,000 00
Total, 835 chains bench walls................	$152,000 00

I recommend the prosecution of this work as of undoubted value to navigation.

Lift-bridges

The lift-bridges constructed by the State over the canals and now in use are:

1. Hotel street, Utica (Erie), hand power, 1874.
2. Railroad street, Mechanicville (Champlain), hand power, 1887.
3. Main street, Fort Plain (Erie), turbine power, 1888.
4. John street, Utica (Erie), hydraulic power, 1888.
5. West street, Syracuse (Erie), hydraulic power, 1888.
6. Glasgow street, Clyde (Erie), turbine power, 1888.
7. Main street, Brockport (Erie), turbine power, 1888.
8. West Main street, Rochester (Erie), hydraulic power, 1889.
9. North Ferry street, Albany (Erie), hydraulic power, 1889.
10. Broad street, Waterford (Champlain), hydraulic power, 1889.

11. Caledonia avenue, Rochester (Erie), hydraulic power, 1891.
12. Church street, Schenectady (Erie), turbine power, 1891, plans being prepared.
13. Nineteenth street, West Troy (Erie), hydraulic power.
14. Rowe street, Rochester (Erie), turbine power.
15. Genesee street, Utica (Erie), hydraulic power.

The construction of each of these bridges has been directed under special appropriations. They are generally of value only to the localities which they serve and not to the canals. Their cost should not be a canal charge.

The number of lift-bridges is increasing yearly and their machinery is delicate. It would be advantageous for the State to employ a competent mechanical engineer to be intrusted with keeping them in order; and they should be overhauled every spring as to line and level of machinery, and condition of suspension cables, which latter should be renewed every four years.

Accidents are liable to occur from carelessness on the part of the bridge-tender in not seeing that the bridge is cleared before it is raised, and any improvement in gates which would lessen this danger would be desirable.

No more lift bridges should be built unless where special and decided necessity exists.

The cost of lift-bridges has been as follows:

1. Hotel street, Utica	$8,729	62
2. Railroad street, Mechanicville	7,998	64
3. Main street, Fort Plain	9,154	66
4. John street, Utica	9,031	63
5. West street, Syracuse	11,966	13
6. Glasgow street, Clyde	8,035	77
7. Main street, Brockport	11,650	47
8. West Main street, Rochester	31,402	17
9. North Ferry street, Albany	12,620	69
10. Broad street, Waterford	8,875	49
11. Caledonia avenue, Rochester	12,571	36
12. Church street, Schenectady	11,525	49
Total lift-bridges to 1891	$143,562	12

Breaks.

1. October 29, 1890. A break occurred on the Champlain canal, 300 feet north of Satterlee's waste-weir, two miles north of Bemis Heights, twenty feet of bank were washed out — delay occasioned, one day.

2. May 1, 1891. Before opening the Champlain canal a break occurred at Bullard's Bend, one mile north of Schuylerville. Twenty feet of bank were washed out and the repairs completed in time for opening on May fifth.

3. June 11th. Twenty-five feet of berme bank were washed away from the east end of the Gatesville aqueduct, three miles east from Sprakers. This was repaired after six days' suspension of navigation at a cost of $1,600.

4. July 20th. Bank washed away out at west end of Crane Brook aqueduct, three miles west from lock 52. This was repaired after ten days suspension of navigation.

5. July 22d. The two piers of Flat Stone creek aqueduct, five miles west of Schenectady, were washed out and the aqueduct entirely destroyed. The cavity was filled in with stone and an aqueduct rebuilt on crib piers after eleven days suspension of navigation..

Abandoned Canals.

The canals abandoned by the State are still the occasion of considerable expense on account of drainage to improve their sanitary condition. Special appropriations have been passed by the Legislature for work at various points on these canals.

These abandoned canals are:

Oneida lake, seven miles, opened 1836, abandoned 1887.

Crooked lake, eight miles, opened 1833, abandoned 1877.

Chemung, thirty-five miles, opened 1831, abandoned 1878.

Chenango, ninety-seven miles, opened 1836, abandoned 1878.

Genesee valley, 125 miles, opened 1861, abandoned 1878.

Chenango extension, thirty-nine miles, never completed, abandoned 1873.

Total number of miles abandoned, 311.

The present canal system was completed as follows:

Erie canal, opened 1825.

Cayuga and Seneca canal, opened 1828.

Oswego canal, opened 1828.

Baldwinsville canal, opened 1839.

Black River canal, opened 1849.

Champlain canal, opened 1822.

Chemung canal, opened 1831, was abandoned in 1878, but four miles reopened 1887.

State Hospital, Poughkeepsie.

At request of the superintendent an examination was made by the Deputy State Engineer of the condition of the hospital reservoirs and advice given to line the banks with bricks laid in cement. The work has been done and the reservoirs appear now to be in first-rate condition.

Highway Bridges.

Several applications have been made under section 145, chapter 568, Laws of 1890, for an examination of bridges, but as no appropriation has been made for this purpose no action could be taken. An amendment to the above section proposed by the State Engineer to the last session of the Legislature would have remedied the omission in the law and would have enabled the State Engineer to examine plans and material before construction and provided means to meet the necessary expenses, without cost to the State. The amendment, however, failed to pass.

It is recommended that this amendment be again introduced in the next session of the Legislature.

Improvements Recommended.

The following improvements are of great importance and should receive the attention of the Legislature:

1. Completion of deepening and widening of Champlain canal to standard dimension of six feet depth and forty-four feet bottom width as established for the improvement by chapter 185, Laws 1876, at a cost of about $1,000,000. This work could be properly

done with a yearly appropriation of $250,000 during the next four years.

2. Rebuilding twenty locks on the Black River canal, which work is imperatively needed to keep the canal open, at a cost of $300,000, which could be distributed over three years with annual appropriation of $100,000.

3. Completion of Forestport dam.

4. Construction of open feeder at Port Byron in place of pipe feeder from Owasco outlet.

5. Construction of one-half mile of new canal at Newark with double combined lock in place of the present three locks at a cost of $300,000 as recommended in my last report. This would remove the only break in the lengthened locks between Little Falls and Lockport, a distance of about 234 miles.

6. Removal of remaining bench walls on the middle division of Erie canal, a length of 835 chains or 10.44 miles, at cost of $152,000, as recommended in 1882.

Carrying out the above improvements would be of undoubted value to the canal and better policy than devoting large amounts of special appropriations of only local interest and of absolutely no benefit to the Erie canal.

Works of 1891.

The final accounts, thirty-one in number, passed in this office during the fiscal year ending September 30, 1891, have been:

Erie Canal Lock Lengthening.

	Final estimate.	Bid.
1. Lock 40	$30,980 81	$31,486 75
2. Lock 41	28,399 22	29,422 05
3. Lock 42	33,770 13	32,415 80
4. Lock 43	30,853 86	31,377 50
5. Lock 46	25,984 42	22,390 25
6. Machinery for locks 40, 41, 42 and 43	4,448 42	4,400 00
	$154,436 86	$151,492 35

Oswego Canal Lock Lengthening.

	Final estimate.	Bid.
7. Lock 8	$34,493 39	$31,731 70
8. Lock 12	38,933 16	37,245 70
	$73,426 55	$68,977 40

Black River Canal Rebuilding.

	Final estimate.	Bid.
9. Lock 1	$12,120 35	$7,881 00

Champlain Canal Improvement.

	Final estimate.	Bid.
10. Champlain improvement No. 1-90 culvert	$6,932 48	$5,597 30
11. Champlain improvement No. 2-90-3,900 ft	31,488 29	29,389 00
12. Champlain improvement No. 3-90-1,400 ft	4,868 29	5,708 75
13. Champlain improvement No. 4-90-1,770 ft	9,729 58	10,144 25
14. Champlain improvement No. 6-90-1,500 ft	5,496 60	5,141 75
15. Champlain improvement No. 7-90-1,495 ft., Whitehall	3,440 14	3,312 70
	$61,955 38	$59,293 75

Erie Canal Improvement.

	Final estimate.	Bid.
16. Albany basin dredging 90	$5,924 74	$5,050 00
17. Moyer Creek Improvement 90	4,109 13	3,695 00
	$10,033 87	$8,745 00

Bridges.

	Final estimate.	Bid.
18. Swing-bridge, Watkins, 89, substructure	$5,851 58	$4,236 00
19. Main street, Fultonville, superstructure	4,359 00	4,359 00
20. Main street, Fultonville, substructure	4,447 69	3,532 25
21. New lock 42, superstructure	2,070 00	2,070 00
22. Caledonia avenue, Rochester, lift, superstructure	10,248 80	10,190 00
23. Caledonia avenue, Rochester, lift, substructure	2,322 56	2,703 00
24. Rotterdam street, Schenectady, altering	450 00	450 00
25. Church street, Schenectady, lift, superstructure	8,346 00	7,975 00
26. Church street, Schenectady, lift, substructure	3,179 49	3,110 00
	$41,275 12	$38,625 25

Miscellaneous.

	Final estimate.	Bid.
27. Canandaigua harbor, 89	$18,472 38	$18,873 00
28. Oneida river improvement	9,072 13	8,050 00
29. James street, Rome, culvert (canceled)	971 40	971 40
30. Havana basin, Chemung canal, 89	10,830 62	10,293 00
31. Chautauqua outlet	12,455 28	9,000 00
	$51,802 31	$47,187 40

Work of 1891 *not yet final.*

	Estimate.	
1. Forestport dam 89	$48,847 50	....
2. Shinnecock canal 90	16,157 00	....
3. Saranac lock 90	4,500 00	....
	$69,504 50	....

Recapitulation.

	Final estimate.	Bid.
Erie locks	$154,436 86	$151,492 35
Oswego locks	73,426 51	68,977 40
Black River locks	12,120 35	7,881 00
Champlain improvement	61,955 38	59,293 75
Erie improvement	16,033 87	8,745 00
Bridges	41,275 12	38,625 25
Miscellaneous	51,802 31	47,187 40
	$405,050 40	$382,202 15

Work of 1890, not yet final, $69,504.50.

Works under Laws of 1891, for which plans and estimates have been made, but which are not yet constructed:

1.	Delaware avenue bridge, Tonawanda, substructure, let on bid	$13,583 00
2.	Delaware avenue bridge, Tonawanda, superstructure, let on bid	14,000 00
3.	Moyer creek improvement, let on bid	16,062 00
4.	Moyer creek bridge, let on bid	1,100 00
5.	Sidewalks, Depuyster street bridge, Rome, let on bid	814 00
6.	Swing-bridge, Schuyler street, Rome, substructure, let on bid	2,572 75
7.	Swing-bridge, Schuyler street, Rome, superstructure, let on bid	1,900 00
8.	Champlain improvement No. 5, 1890, let on bid	18,299 25
9.	Holley culvert, old canal, let on bid	1,439 50
10.	Medina sewer, Rock street, let on bid	8,514 00
11.	West Troy lift-bridge, substructure, let on bid	2,764 50
12.	West Troy lift-bridge, superstructure, let on bid	8,695 00
13.	Culvert, Smith street, Brockport, let on bid	3,865 50
14.	Culvert, Gordon's mill, Brockport, let on bid	4,055 00
15.	Corning wall, let on bid	5,245 00
16.	Forestport clearing	....
17.	Rowe street lift-bridge, Rochester, substructure,	....

18. Rowe street lift-bridge, Rochester, superstructure	....
19. Gate and bridge, Shinnecock canal	....
20. Open feeder, Port Byron	....
21. Stone dam, Baldwinsville	....
22. Foot-bridge, Schuyler street, Utica	....
23. Adams basin culvert, rebuilding	....
24. Combined lock, Newark	....
25. Glens Falls feeder, head wall, let on bid	$2,944 75

Works under Contract for this Winter.

Eastern division.— Shinnecock canal, Moyer creek improvement, Moyer creek bridge.

Champlain improvement No. 5-90.— Lift bridge, West Troy, substructure and superstructure.

Middle division.— Depuyster street, Rome, sidewalks; swing-bridge, Schuyler street, Utica, substructure and superstructure.

Western division.— Tonawanda, bridge, Delaware avenue, substructure and superstructure; Holley culvert; Medina sewer; Brockport culverts; Corning slope wall.

Cost of Lock Lengthening.

The average cost of thirty-eight locks lengthened on the Erie canal is $25,950.61, to which must be added about $3,000 for engineering and inspection, making a total average of $29,000 per lock.

Average bid per lock (Erie), 1886	$20,549 80
Average bid per lock (Erie), 1887	26,005 33
Average bid per lock (Erie), 1888	27,159 69
Average bid per lock (Erie), 1889	25,922 12
Average bid per lock (Erie), 1890	30,624 42
Average bid per lock (Erie), 1891	29,418 47
Total amounts expended on Erie locks, 1884 to 1891	1,087,905 39
On Oswego locks, 1886 to 1891	290,547 09
On Black River locks, 1887 to 1891	68,981 93
On Champlain improvement, 1887 to 1891	519,565 47

Not including inspection and advertising.

Summary of Contracts and Estimates.

Summary of estimates and contracts in this department during year ending 30th September, 1891:

	Number.	Amount.
Preliminary estimates	29	$500,925 23
Contracts let	22	170,240 75
Final accounts	31	405,050 41
Contracts in progress	12	139,275 00
Monthly estimates, October, 1890	18	$35,529 88
Monthly estimates, November, 1890	16	28,324 00
Monthly estimates, December, 1890	19	42,728 45
Monthly estimates, January, 1891	20	49,002 15
Monthly estimates, February, 1891	17	41,417 00
Monthly estimates, March, 1891	16	47,200 00
Monthly estimates, April, 1891	23	50,365 00
Monthly estimates, May, 1891	7	11,211 42
Monthly estimates, June, 1891	6	8,053 49
Monthly estimates, July, 1891	12	33,150 61
Monthly estimates, August, 1891	11	37,514 53
Monthly estimates, September, 1891	6	15,223 91
		$399,720 44

Conclusion.

Some idea of the magnitude of the interests, the engineering charge of which is confided to this department, is suggested by the statistics above given. The canals of the State have a length of over 628 miles; the number of structures is over 2,160. Under the law, the engineering connected with the improvement and maintenance of this enormous water bearing construction is in charge of the State Engineer and his corps, and this alone is a professional responsibility of a most serious character. The State Engineer, as has been outlined in this report, is also charged with other responsibilities in connection with the public lands of the State and their sales or grants, and he is also a member of various commissions and boards. During the past four years the dignity and importance of this department, as one of the great executive offices of the Empire State, has been carefully maintained. The functions of the office are concerned with public affairs of the highest importance and of the most serious character and demand in their professional relations the treatment and solution of many engineering questions and the design in general and in detail of all measures and works necessary for the construction and maintenance of these great charges of the State.

Respectfully.
JOHN BOGART,
State Engineer.

APPENDIX A.

1. STRUCTURES ON THE NEW YORK STATE CANALS.
2. BRIDGES ON THE NEW YORK STATE CANALS.
3. RESERVOIRS, NEW YORK STATE CANALS.
4. ENGINEERING EXPENDITURES, 1891.
5. TABLE OF DATES OF LAWS AND OF WORKS OF CANAL IMPROVEMENTS.
6. DISTANCES ALONG THE ERIE CANAL.

STRUCTURES ON NEW YORK STATE CANAL SYSTEM.

LOCATION.	AQUEDUCTS		DAMS.		LOCKS											
						SINGLE CHAMBERED LOCKS.				TWIN LOCKS (TWO CHAMBERS SIDE BY SIDE), STONE.			OTHER LOCKS.			
						STONE.										
	Number of.	Aggregate number of spans.	Number of.	Aggregate length.	Total lift of canals.	Unlengthened.	Double length, taking two boats.	Of wood.	Total.	Unlengthened.	One chamber double length, taking two boats.	Total	Guard locks.	Sloop and steamboat locks.	Weigh locks.	Grand total.
Erie canal	32	168	10	....	660	....	......	....	....	34	38	72	1	2	6	81
Erie canal feeders	1	1	33	....	....	....	......	....	....	....	......	....	....	....	....	.....
Erie canal, West Troy side cut	....	....	....	....	24.7	....	......	....	....	2	......	2	....	....	....	2
Erie canal, Port Schuyler side cut	....	....	....	....	24.7	2	......	....	2	....	......	....	....	....	....	2
Erie canal, slips and canals, Buffalo	....	....	....	....	....	....	......	....	....	....	......	....	....	....	....	.....
Champlain canal, including side cuts	4	6	7	....	175	21	......	....	21	....	......	....	5	1	1	28
Champlain canal feeders*	....	....	1	....	132	13	......	....	13	....	......	....	1	....	....	14
Oswego canal	1	1	7	....	155	7	11	....	18	....	......	....	6	....	1	25
Oswego canal branches	....	....	3	....	16	1	......	1	2	....	......	....	....	2	....	4
Cayuga and Seneca canal	....	....	4	....	83	11	......	....	11	....	......	....	....	....	....	11
Cayuga and Seneca canal, Ithaca inlet	....	....	....	....	....	....	......	....	....	....	......	....	....	....	....	.....
Black River canal	6	24	2	....	1,082	109	......	....	109	....	......	....	....	....	....	109
Black River canal improvement	....	....	3	....	9	....	......	....	....	....	......	....	....	†2	....	2
Black River canal feeders	....	....	12	....	5	....	......	....	....	....	......	....	2	....	....	2
Black, Beaver and Moose rivers, not canal	....	....	3	....	....	....	......	....	....	....	......	....	....	....	....	.....
Chemung canal	....	....	....	....	....	....	......	....	....	....	......	....	....	....	....	.....
Total of items	....	....	....	....	2,366.4	164	11	1	176	36	38	74	15	6	8	.....
Grand total of structures	44	200	85	....	....	....	......	....	....	....	......	....	...	....	....	280

* This includes the Glens Falls feeder.

† These two steamboat locks are of wood.

STRUCTURES ON NEW YORK STATE CANAL SYSTEM — (*Concluded*).

LOCATION.	CULVERTS.										Waste weirs.	Spillways and sluices.	Guard gates and bulk-heads.	† BRIDGES.			Miscellaneous structures.	Grand total.
	STONE ARCH.																	
	One span.	Two spans.	Three spans.	Four spans.	Stone box.	Composite.	Wooden box.	Iron or vitrified pipe.	Miscellaneous.	Total.				State property.	Not State property.	Total.		
Erie canal	158	17	2	2	35	79	8	10	1	312	50	6	7	518	92	610	4	1,112
Erie canal feeders	....	....	....	....	....	....	....	....	....	8	....	13	4	76	1	77	10	146
Erie canal, West Troy side cut	....	....	....	....	....	....	....	....	....	....	....	....	....	5	....	5	....	7
Erie canal, Port Schuyler side cut	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	......	....	2
Erie canal, slips and canals, Buffalo	....	....	....	....	....	....	....	....	....	....	....	....	....	15	....	15	....	15
Champlain canal, including side cuts	....	....	....	....	....	....	....	....	....	25	22	4	....	152	28	175	....	265
Champlain canal feeders*	....	....	....	....	....	....	....	...	....	2	1	8	....	12	4	16	....	42
Oswego canal	1	....	....	....	....	5	....	....	....	6	....	61	11	37	10	47	....	158
Oswego canal branches	....	....	....	..	....	....	....	....	....	....	1	....	1	19	3	22	....	31
Cayuga and Seneca canal	....	....	..	....	....	9	....	....	..	9	1	24	....	33	5	38	8	95
Cayuga and Seneca canal, Ithaca inlet	....	....	....	....	....	....	....	....	....	....	....	....	....	3	....	3	8	6
Black River canal	....	....	....	....	....	....	...	....	...	....	11	4	....	64	3	67	....	199
Black River canal improvement	....	....	....	...	....	....	....	....	....	....	....	....	....	6	1	7	....	12
Black River canal feeders	....	....	....	....	....	....	....	...	....	3	7	2	2	21	....	21	5	54
Black, Beaver and Moose rivers, not canal	....	....	....	....	....	....	....	....	....	....	....	....	3	4	....	4	....	10
Chemung canal	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	2	4	6
Total of items	....	....	....	....	....	....	....	....	...	....	....	....	....	967	141	......	....	.....
Grand total of structures	....	....	....	....	....	....	....	....	....	365	93	122	28	....	....	1,109	34	2,160

* This includes the Glens Falls feeder.

† For details of State bridges, see table of bridges.

Bridges on New York State Canal System.

LOCATION.	Kinds of Bridges.																					
	Bridges of wood and wood and iron.																Iron bridges. Cast iron.					
	Whipple trapezoidal wooden chords.		Whipple trapezoidal wrought iron lower chord.		Wooden latticed truss.		King post, swing bridges.		Wooden draw bridges.		Suspension foot bridges.		Wooden stringer bridges	Howe truss.	Wooden roof truss.	Wooden float bridge.	Whipple cast arch.		Whipple tubular arch.	Trapezoidal tubular truss
Ownership and Maintenance.	State.	Not State.	State.	Not State.	State.	Not State.	State.	Not State.	State.	Not State.	State.	Not State.	State.	Not State.	Not State.	State.	State.	Not State.	State.	State.
Erie canal	129	5	99	1	1	1	1	....	2	1	2	10	4	8	1	....	154	2	2	5
Erie canal feeders	35	....	....	....	....	....	....	....	....	....	....	....	85	....	....	....	4	....	....	....
Erie canal, West Troy side cut	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....
Erie canal slips and canals at Buffalo	....	....	....	....	....	....	....	....	....		....	....	....	....	....	....	9	....	....	....
Champlain canal and side cuts	80	7	43	....	....	....	....	....	....	....	....	2	4	....	....	....	6	....	....	....
Champlain canal feeders	8	2	3	....	....	....	....	....	....	....	....	....	....	1		....	..	....	....	....
Oswego canal	10	2	7	....	....	....	....	....		....	....	....	1	....	....	....	14	....	1	1
Oswego canal branches	4	....	....	....	....	....	6	1	....	....	....	....	2	1	....	1	3	....	....	1
Cayuga and Seneca canal	11	....	....	....	....	....	1	....	1	....	....	....	8	1	....	....	10	....	....	1
Cayuga and Seneca canal, Ithaca inlet	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Black river canal	39	....	6	1	....	....	....	1	....	....	....	....	2	....	....	....	14	....	2	....
Black river canal improvement	..	....	....	....	..	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Black river canal feeders	14	....	....	....	....	....	....	....	..	....	....	....	5	....	....	....	1	....	....	....
Black, Beaver and Moose rivers, not canal	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Chemung canal	....	..	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....
Total bridges, State property	331	....	158	....	1	....	8	....	8	....	2	....	61	....	....	1	217	....	5	8
Total bridges not State property	....	16	....	2	....	1	....	2	....	1	....	12	....	6	1	....	....	2	....	....
Grand total		347		160		2		10		4		14	61	6	1	1		219	5	8

BRIDGES ON NEW YORK STATE CANAL SYSTEM — (*Continued*).

LOCATION.	KINDS OF BRIDGES.																				
	IRON BRIDGES.																				
	CAST IRON.						WROUGHT IRON.														
	Whipple trapezoidal truss.		Deck Whipple trapezoidal.	Bollman truss.	Swartz suspended arch.	Cast pipe arch.	Wrought latticed truss		Trapezoidal riveted truss.		Trapezoidal riveted swing.		Pin trapezoidal.		Deck trapezoidal truss.	Lift bridges, trapezoidal, Hilton and Whipple		Plate girder, fixed.		Plate girder, swing.	
OWNERSHIP AND MAINTENANCE.	State.	Not State.	State.	State.	State.	State.	State.	Not State.	State	Not State.	State.	Not State.	State.	Not State.	State	State.	Not State.	State.	Not State.	State.	Not State.
Erie canal	8			8	4	10	27	20	12	9	5	3	6	18		10	5	2			2
Erie canal feeders						1															1
Erie canal, West Troy side cut	1																			2	
Erie canal slips and canals at Buffalo				2			2				1										
Champlain canal and side cuts									5	8				8		2	1		2		
Champlain canal feeders										1											
Oswego canal		1	1					1						1		1	1	1			1
Oswego canal branches											1	1									
Cayuga and Seneca canal								1		1				1	1		1				
Cayuga and Seneca canal, Ithaca inlet											8										
Black river canal									1	1											
Black river canal improvement																					
Black river canal feeders																					
Black, Beaver and Moose rivers, not canal																					
Chemung canal																		1			
Total bridges, State property	9		1	10	4	11	29		18		10		6		1	13		4		2	
Total bridges, not State property		1						22		20		4		23			8		2		4
Grand total		10	1	10	4	11		51		38		14		29	1		21		6		6

BRIDGES ON NEW YORK STATE CANAL SYSTEM — (*Concluded*).

LOCATION.	KINDS OF BRIDGES.																	Total State bridges.	Tot'l not State bridges.	Grand total.
	IRON BRIDGES.														STONE.					
	WROUGHT IRON.																			
	Deck girder	Wrought iron arch truss.		Pratt truss, riveted.		Cooper tubular truss	Soule's angle arch.	Simm's tubular truss.	Alden truss, riveted.	Bowstring.		King arch truss	Wrought roof truss.	Suspension.	Stone arch bridge.	Miscellaneous.				
OWNERSHIP AND MAINTENANCE.	State.	State.	Not State.	State.	Not State.	State.	State.	State.	State.	State.	Not State.	Not State.	State.	Not State.	State.	State.	Not State.			
Erie canal		7	1	8	4	3	1	1	1	8	1		2	5	1			518	92	610
Erie canal feeders	1																	76	1	77
Erie canal, West Troy side cut																		5		5
Erie canal slips and canals at Buffalo										1								15		15
Champlain canal and side cuts		12																152	23	175
Champlain canal feeders		1																12	4	16
Oswego canal					1							2						37	10	47
Oswego canal branches							1											19	3	22
Cayuga and Seneca canal																		83	5	88
Cayuga and Seneca canal, Ithaca inlet																		8		8
Black river canal																		64	3	67
Black river canal improvement																6	1	6	1	7
Black river canal feeders																1		21		21
Black, Beaver and Moose rivers, not canal																4		4		4
Chemung canal																		2		2
Total bridges, State property	1	20		8		3	2	1	1	9			2		1	11		967		
Total bridges, not State property			1		5						1	2		5			1		142	
Grand total	1	21		8		3	2	1	1	10		2	2	5	1	12				1,109

CANAL RESERVOIRS, 1891.

LEVEL SUPPLIED.	Reservoir.	Completed.	Elevation + T. W.	Distance to canal.	Flow-line area.	Flow-line.	Average area.	Average depth.	Capacity.	Original cost.	Cost per million cubic feet.
			Feet.	Miles.	Acres.	Feet.	Acres.	Feet.	Cubic feet		
Rome level — Erie	....	....	428.40	....	....	....	....	....	....	....	....
	Woodhull	1859	1,854.00	25.0	1,236.00	16.00	1,118.0	18.0	876,550,000	$24,089 38	$27 47
(Through Forestport pond and Black River canal)	Bisby lake, No. 1	1881	2,018.00	27.8	156.93						
	Bisby lake, No. 2	1881	2,018.00	27.0	204.71	4.00	....	3.5	40,000,000	....	....
	Bisby lake, No. 3	1891	2,006.00	26.0	41.61						
	Sand lake	1872	1,808.00	24.0	344.50	18.00	306 0	15.0	199,879,822	5,505 23	27 71
	Chubb lake	1881	1,599.00	20.5	530.00	22.00	200.0	4.0	34,848,000	8,134 46	233 43
	White lake	1881	....	18.0	332.00	5.00	296.0	5.0	64,468,800	5,101 97	79 27
	Canachagala lake	1881	....	32.0	347.51	4.00	320.0	4.0	55,756,800	1,455 84	26 11
	North Branch lake	1857	1,821.00	25.5	423.00	28.00	277.0	28.0	337,851,360	34,636 92	102 22
	South Branch lake	1859	2,019.00	26.0	518.00	26.00	372.0	26.0	421,312,320	20,167 93	47 87
	Twin lakes	1891	....	22.0	212.72	6.00	175.0	8.0	60,984,000	....	....
	Forestport pond	1853	1,124.00	10.5	160.00	....	....	2.0	13,921,920	....	....
	Forestport reservoir	....	1,139.00	12.5	793.00	21.00	700.0	7.0	212,444,000	....	....
Boonville level — Black River	....	....	1,121.40	25.0	....	....	....	....	....	....	....
Jordan level — Erie	....	....	408.57	....	....	....	....	....	....	....	....
	Skaneateles lake	1844	864.10	9.0	8,320.00	....	....	9.0	2,174,512,000	14,927 55	6.87
	Otisco lake	1869	....	13.0	2,200.00	....	....	10.0	784,000,000	48,753 25	55.81
Port Byron level	....	....	403.00	....	....	....	....	....	....	....	....
	Owasco lake	1866	704.00	12.0	680.00	....	....	5.0	1,481,040,000	36,295 79	25.59
Rochester level — Erie	....	....	508.00	....	....	....	....	....	....	....	....
Cuba level — Genesee Valley	....	....	1,489.00	....	....	....	....	....	....	....	....
	Oil creek reservoir	1858	....	91 0	605.00	65.00	525.0	15.0	435,738,000	69,215 83	158 85
	Rockville reservoir	1842	....	33.0	....	....	72.0	20.0	18,200,000	7,711 11	423 68
Rome level — Erie	....	....	428.40	....	....	....	....	....	....	....	....
	Erieville	1850	1,577.00	20.0	340.00	46 00	....	21.5	318,424,000	36,837 03	115 68
	Cazenovia lake	1857	1,176.00	10.0	1,778.00	....	....	4.5	348,523,000	10,884 73	31 23
	De Ruyter reservoir	1863	1,276.00	25.0	626.28	....	....	18.5	504,468,000	78,761 12	156 13
	Jamesville reservoir	1874	585.00	6.0	252.00	....	240.0	16.0	170,000,000	150,000 00	882 35
(Through Oriskany creek feeder)	Hatch's lake	1836	....	36.0	134.00	15.00	....	10.0	58,370,400	4,463 72	76 47
	Eaton brook reservoir	1836	....	38.0	254.00	60.00	244.0	50.0	553,212,000	28,059 31	50 72
	Bradley brook reservoir	1836	....	35.0	134.00	30.00	....	25.0	145,926,000	16,158 58	110 73
	Leland pond	1836	....	25.0	173.00	13 00	150.0	8.0	59,287,040	8,893 92	150 02
	Madison brook reservoir	1836	1,127.00	29.0	345.00	55.00	235.0	45.0	460,647,000	36,301 19	78 80
	Kingsley brook reservoir	1867	....	33.0	113.00	....	....	20.0	96,445,600	80,481 25	817 54

ENGINEERING EXPENSES OF THE DEPARTMENT FOR THE FISCAL YEAR — ORDINARY.

Chapter 266, *Laws* 1890.

DIVISION.	CANALS.				
	Erie.	Champlain.	Oswego.	Black river	Cayuga andSeneca
Eastern	$6,817 65	$3,647 29	....	....	....
Middle	6,612 55	....	$2,097 60	$1,255 61	$645 29
Western	8,518 77	....	....	....	....
	$21,948 97	$3,674 29	$2,097 60	$1,255 61	$645 29

Total $29,616 76

EXTRAORDINARY IMPROVEMENTS — LENGTHENING LOCKS, ETC.

Chapter 168, *Laws* 1890.

DIVISION.	CANALS.					
	Erie.	Bottoming out Erie.	Champlain.	Albany basin.	Oswego.	Black river.
Eastern	$11,156 32	$338 85	$9,971 10	$212 90	....	....
Middle	3,102 52	313 16	....	....	$5,201 36	$1,304 44
Western	....	587 15	....	....	....	....
	$14,258 84	$1,239 16	$9,971 10	$212 90	$5,201 36	$1,304 44

Total $32,187 80

SPECIAL APPROPRIATIONS.

Eastern Division.

Main street bridge, Fultonville, chap. 333, 1890....	$205 14
Church street bridge, Schenectady, chap. 77, 1891....	875 54
Lift-bridge, Nineteenth street, West Troy, chap. 239, 1891	397 96
Repairing Moyer creek, chap. 113, 1891............	437 44
Monuments, examination and maps, chaps. 295, 1890, and 302, 1891	1,468 30
Survey, Board of Claims, chaps. 295, 1890, 302, 1891,	3,352 55
Saranac lake improvement, chap. 359, 1890.........	284 54
Shinnecock and Peconic canal, chap. 436, 1890......	1,822 69
Survey Rondout creek, chap. 295, 1890............	101 94
Deficiency ordinary fund, chap. 570, 1889..........	1,386 27
	$10,332 37

Middle Division.

Culvert, James street, Rome, chap. 81, 1890........	$38 31
Improving old Erie canal, Rome, chap. 385, 1891....	199 45
Swing bridge, Schuyler street, Utica, chap. 69, 1891..	111 62
Reservoir near Forestport pond, chap. 274, 1889....	1,940 38
Clearing flow ground near Forestport, Black river, chap. 342, 1891	700 05
Basin at Havana, etc., chap. 416, 1888.............	378 72
Improving harbor at foot of Canandaigua lake, chap. 204, 1889	62 17
Survey, Board of Claims, chap. 295, 1890...........	1,140 30
Survey of claims, chap. 302, 1891..................	738 52
	$5,209 52

Western Division.

Tonawanda bridge, chap. 82, 1891.................	$664 49
Caledonia avenue bridge, Rochester, chap. 117, 1890,	352 15
Survey, Board of Claims, chap. 295, 1890...........	236 74
Survey, Board of Claims, chap. 302, 1891..........	463 21
Dredging Chautauqua lake outlet, chap. 167, 1890...	1,120 43
	$2,837 02

SUMMARY.

Ordinary.

Eastern division	$10,491 94	
Middle division	10,611 05	
Western division	8,513 77	
		$29,616 76

Extraordinary Improvements.

Eastern division	$21,729 17	
Middle division	9,921 48	
Western division	537 15	
		32,187 80

Special Appropriations.

Eastern division	$10,332 37	
Middle division	5,209 52	
Western division	2,837 02	
		$18,378 91
Total for engineering		$80,184 47

TABLE OF DATES OF LAWS AND OF WORKS OF CANAL.

Prepared by A. S. C. WURTELE, Deputy State Engineer.

ERIE CANAL.

1768. Improvement of Mohawk river, recommended by Governor Sir Henry Moore to Assembly.

1788. Elkanah Watson advocated connecting Wood creek with the Mohawk and improving the Mohawk.

1791. Governor G. Clinton urged to Assembly the necessity of improving the natural water channels.

Chapter 53, 1791. Commissioners of Land Office authorized to survey between Mohawk river, at Fort Stanwix, and Wood creek and make estimate for a canal.

Chapter 8, 1792. Locks to be seventy feet by ten feet — two feet draft of boats.

Chapter 40, 1792. Western Inland Lock Navigation Company incorporated to open navigation between the Hudson to Lake Ontario and Seneca lake. Bridges to be built, where canals cross roads, fit for carts and wagons.

Chapter 38, 1795. State Treasurer instructed to subscribe to 200 shares (twenty-five dollars) of the stock of Western Inland Navigation Company.

Chapter 61, 1796. State Treasurer directed to advance £15,000 ($37,500) to Western Inland Lock Navigation Company, secured by mortgage on real estate of said company at Little Falls.

1796. Western canals opened from Schenectady to Seneca Falls for boat sixteen tons. Little Falls locks completed.

Chapter 92, 1798. Niagara Canal Company incorporated to construct canal around Niagara Falls, from Steadman's landing to opposite Queenstown landing. (Nothing done.)

Chapter 98, 1802. Comptroller directed to accept shares of Western Inland Navigation Company in payment of debt to state.

Chapter 188, 1811. Commission appointed to consider inland navigation.

Chapter 231, 1812. Commissioners authorized to purchase rights of Western Inland Lock Navigation Company.

Chapter 212, 1816. Hudson and Mohawk Lock Navigation Company incorporated — canal around Cohoes Falls and improving river to Schenectady.

Chapter 105, 1819. Canal Commissioners to open communications between Seneca river, Lake Erie, Mohawk and Hudson rivers.

October 22, 1819. Middle section completed (ninety-four miles)—Utica to Seneca river.

July 1, 1820. Tolls first levied on canal.

October 20, 1820. Purchase of Western Inland Lock Navigation Company completed.

1821. Canal completed from Utica to Little Falls.

1822. Canal completed from Little Falls to Schenectady.

1822. Genesee river feeder completed; lock at head.

1822. Collectors' offices established.

Chapter 111, 1823. Commissioners appointed to construct basin at Albany, with lock at lower end. Owners of mill privileges to use surplus water from dams erected by Canal Commissioners.

1823. Canal completed from Rochester to Brockport, including Rochester aqueduct.

1823. Canal completed from Schenectady to Albany.

1824. Canal completed from Brockport to Lockport.

Chapter 275, 1825. Canal appraisers appointed.

Chapter 277, 1825. Canal Commissioners to construct canal from Squaw island to Buffalo creek.

October 26, 1825. Canal completed, Albany to Buffalo, at Squaw island, 363 miles; eighty-four locks, ninety feet by fifteen feet, 689 feet lockage.

1823. Tonawanda dam built 1823 to turn water into Oak Orchard creek. Open cuts, four and eight one-hundredths miles; creek excavated, three and twenty-one-hundredths miles; Oak

Orchard creek, three and twenty-one-hundredths; raceway to **canal, one and ten-one-hundredths; total, eleven and fifty-five-hundredths miles.**

Descent in canal, Lake Erie to Tonawanda, one inch per mile, eight miles.

Descent in canal, Lake Erie to Pendleton, two and one-half inches per mile, twelve miles.

Descent in canal, Lake Erie to Lockport, one and one-half inch per mile, seven miles.

Descent in canal, Lake Erie to Rochester, one and one-half inch per mile, sixty-five miles.

1832. Hutchison surveys and maps, Canastota to Hudson river.

Chapter 312, 1834. Canal commissioners to construct second set of locks, Albany to Syracuse, and to rebuild Seneca aqueduct, forty-one feet wide.

Size proposed by Hutchison, 100 by fifteen feet.

Chapter 274, 1835. Canal Commissioners to enlarge canal, and construct double locks.

1835. Enlargement estimate, $12,448,541.60.

Canal board fixed enlargement at seventy inches surface, seven feet water. Locks 110 by eighteen.

1836. First enlargement, work let.

Chapter 116, 1838. City of Buffalo, to construct Hamburg Street canal.

1838. Enlargement of Genesee River feeder, completed.

Chapter 247, 1838. Canal Commissioners to improve Tonawanda and Ellicott creek as proposed by Alfred Barrett.

1838. Lockport combines put under contract.

Chapter 308, 1840. Canal Commissioners to complete Hamburg Street canal.

1840. Locks 47 and 48 completed.

1840. Oak Orchard feeder, Medina, enlarged.

1841. High level plan of crossing Cayuga marshes adopted.

Chapter 218, 1841. Canal department located in State Hall.

Chapter 248, 1841. Canal Commissioners to contract with Nine Mile Creek Canal Association for land and water not used in feeder.

1841. Petition for incorporation of a company to complete canal.

Chapter 114, 1842. Stop law, all work on canals stopped except to secure work in progress.

1842. Childs proposed using Skaneateles lake as a reservoir.

1842. Rochester enlarged aqueduct completed, 800 feet long, forty-five feet water, cost, $445,347.

1844. Skaneateles Lake reservoir completed.

1843. North tier Lockport combines brought into use.

Chapter 335, 1844.—Railroads parallel to canals to pay tolls to canal.

1846. Constitution, article VII, section 6. Legislature shall never sell any canal, adopted third November.

Chapter 259, 1847. Resumption of enlargement to complete one set of locks, Albany to Syracuse.

Chapter 200, 1849. Albany basin transferred to State.

1849. Plan of locks changed; big bevel dispensed with.

February 17, 1849. Bench walls dispensed with on canal by Canal Commissioners.

Chapter 200, 1849. Albany basin bought by State from city of Albany.

Chapter 222, 1849. Lake Conesus, Honeoye, Canadice and Hemlock to be used for canal purposes.

Chapter 497, 1851. Tolls on railroads abolished.

Chapter 329, 1850. Contracting board established.

Chapter 385, 1851. Balance of revenue to be applied to completion.

Chapter 327, 1854. Canal repairs to be let by contract.

Chapter 270, 1852. Contracts to be filed in Canal Department, repealed 473 53.

1854. Constitution, article VII, section 3, Legislature to appropriate annually for enlargement of canals; adopted February fifteen.

October 16, 1856. Work on enlargement suspended for want of funds.

1856. Rocky Rift feeder completed; Mohawk at Rome completed.

1857. Cazenovia Lake reservoir brought into use.

Chapter 213, 1860. Bevels in enlarged locks to be cut off and all bridges to be raised twelve feet above water surface.

1861. De Ruyter reservoir brought into use.

Chapter 169, 1862. Enlargement declared complete on September first. Canal 350 1-2 miles, seventy feet surface, fifty-six feet bottom, seven feet water, seventy-two locks 110 by eighteen; fifty-seven double and fifteen single. All double from Troy to Port Byron.

Fall, Black Rock to Tonawanda, 0.080 per mile, 7.86 miles = .629.

Fall, Black Rock to Sulphur Spring, 0.014 per mile, 13.24 miles = 191.

Fall, Black Rock to Murphy's, 0.268 per mile, 2.45 miles = .657.

Fall, Black Rock to Lockport, 0.096 per mile, 2.73 miles = .267.

Fall, Black Rock to Rochester, 0.048 per mile, 62.5 miles = 3.000.

Chapter 40, 1863. Canal Board to accept conveyance of Clark and Skinner canal, Buffalo.

March 25, 1863. Concurrent resolution for estimate on gunboat locks 225 feet by twenty-six feet.

Chapter 72, 1863. Nine-mile creek feeder to be made navigable to Camillus.

Chapter 354, 1864. Side-cut locks to be built at Union street, West Troy.

Chapter 355, 1864. Lock No. 2 to be rebuilt.

1864. Dam at Rochester completed.

Chapter 727, 1865. Encroachment on canal lands to be removed.

Chapter 477, 1865. Division and resident engineers to be appointed.

Chapter 657, 1866. Exceptions to 727, 1868.

Chapter 543, 1866. Maps of canal to be completed.

Chapter 503, 1866. Albany basin to be narrowed.

1867. Oak Orchard creek deepened through rock.

1867. Resolution of Canal Board to build all bridges of iron.

Chapter 238, 1867. Two-thirds owners of lot must consent to narrowing of Albany basin.

Chapter 621, 1867. Tolls to be collected on Mohawk basin, West Troy.

Chapter 877, 1869. Locks on western division to be doubled.

Chapter 877, 1869. Bridges to be built of iron; bench walls to be removed.

March 18, 1870. Report of special committee on cases of surplus water.

1870. Lock 49 widened to twenty feet.

Chapter 55, 1870. Contracting board and contract repair system abolished.

Chapter 576, 1870. Cable-towing system to be tried.

Chapter 963, 1871. Tonawanda dam to be cut down two feet.

Chapter 602, 1871. U. C. & S. R. R. to build bridge at Lock 46.

Chapter 868, 1871. Steam propulsion on canals to be tried and prizes to be awarded.

September 5, 1871. Crib ordered between canal and Black Rock Harbor, 120 feet from bank.

Chapter 778, 1871. Locks 47 and 48 to be widened.

1871. First steamer on canal, the A. H. Dawson.

Chapter 652, 1872. Swing-bridge to be built at Hotel street, Utica.

1872. Twelve steamers competed for prizes, but no award.

Chapter 550, 1872. Williamson to try road steam-engine towing on five miles of canal.

1872. Doubling lock No. 2; completed locks 47 and 48 widened to twenty feet.

1872. Heath's tumble gates inserted at locks 47 and 48.

Chapter 653, 1872. Swing-bridge to be built at Buffalo street, Rochester.

1872. Otisco lake reservoir completed.

Chapter 766, 1873. Whipple lift-bridge to be built at Hotel street, Utica.

1873. Lock 72 and Newark locks 57, 58 and 59 doubled.

1873. Six steamers competed for prizes, but no award.

Chapter 399, 1874. Tonawanda side-cut lock to be built.

1874. Constitution, article VII, § 6. Legislature not to sell Erie, Oswego, Champlain or Cayuga and Seneca canal; adopted, third November.

Chapter 618, 1874. Prizes paid, steamer Baxter, $35,000, Newman, $15,000, Central City, $5,000.

1874. Fifteen steamers on canal.

1874. Canal maps completed.

1875. Doubling locks completed, Albany to Buffalo.

Chapter 499, 1875. Canal Commissioners to report if any lateral canal shall be sold.

Chapter 385, 1876. Appointment and removal of engineers vested in the State Engineer.

Chapter 388, 1876. Canal Board to investigate canals.

Chapter 425, 1876. All appropriations for new or extraordinary work repealed except as to Champlain and Oneida Lake canals.

Survey to be made as to condition of canals.

1876. Survey as to condition of canals completed.

Chapter 369, 1877. Canal Board may close Genesee River feeder.

1876. Constitution, article V, § 3. Superintendent of Public Works to take place of Canal Commissioners, who are abolished.

1877. State Engineer reported that Genesee feeder can not be closed.

1878. Philadelphia system of double-headers introduced.

1877. Division wall in Black Rock Harbor, 10,455 feet completed, 897 feet not done.

1878. Nineteen steamers on canals.

Chapter 152, 1879. Superintendent of Public Works to make permanent appropriations.

1880. Cable towing tried between Utica and Syracuse, but abandoned.

Chapter 99, 1880. State Engineer to make all plans for improvement.

Chapter 359, 1880. Superintendent of Public Works to keep Genesee River feeder in good condition.

November 7, 1882. Constitution, article VII, § 6. Legislature not to sell Erie, Oswego, Champlain, Cayuga and Seneca and Black River canal.

Chapter 340, 1881. Lift or swing bridge to be built at Brockport.

Chapter 569, 1881. Powers of constructing board conferred on Superintendent of Public Works.

1882. Turbines used in locks for hauling boats.

1882. Canal deepened at Sulphur Springs.

November 7, 1882. Constitution, article VII, § 3. No tolls to be imposed on canals.

Chapter 165, 1883. Collectors and weighmasters abolished.

Chapter 215, 1883. Canal appraisers abolished.

1883. Ninety-two steamers on canals.

1883. West Shore built along canal fourteen and seventy-four hundredths miles, Montgomery and Herkimer counties.

Chapter 448, 1883. Old navigation lock at Little Falls to be preserved.

Chapter 80, 1884. Lock 50 to be lengthened to pass two boats.

April, 1884. Report of Superintendent of Public Works on encroachment.

Chapter 294, 1884. Surplus water of Rome level not to be discharged into Butternut or Limestone creeks.

Chapter 362, 1884. Ice on canals may be cut by citizens for their own use.

April 1, 1884. Report on encroachments.

Chapter 168, 1884. Little Falls to be repaid for abating nuisance on abandoned canal in village.

Chapter 312, 1885. Old canal at Rome to be drained.

Chapter 77, 1885. Erie canal at Buffalo from Jersey street to Hudson street to be protected from lake encroachments.

1885. Buffalo trunk sewer completed.

1885. Lengthening lock 50 to 220 feet completed.

1887. Locks lengthened, 47, 48, 49, 51 and 52.

Chapter 528, 1887. Registry of canal boats transferred from Comptroller to Superintendent of Public Works.

Chapter 118, 1887. Reappropriation for lift or swing bridge at Brockport; built 1888.

Chapter 402, 1887. Lift-bridge to be built at Glasgow street, Clyde; built 1888.

Chapter 311, 1887. Lift-bridge to be built at Main street, Fort Plain; built 1888.

Chapter 233, 1887. Lift-bridge to be built at West street, Syracuse; built 1888.

Chapter 274, 1887. Lift-bridge to be built at John street, Utica; built 1888.

Chapter 400, 1888. Lift-bridge to be built at Ferry street, Albany; built 1889.

Chapter 546, 1888. Lift-bridge to be built at Geneva street, Lyons.

Chapter 351, 1888. Lift-bridge to be built at West Main street, Rochester; built 1889.

Chapter 417, 1888. Lift-bridge to be built at Schuyler street, Utica.

1888. Locks lengthened, 31, 32, 33, 34, 35, 44, 45, 53, 54, 55, 56, 60, 61, 62, 72.

1889. Locks lengthened, 27, 28, 29, 30, 63, 64.

Chapter 291, 1889. Skaneateles lake water, to be used by city of Syracuse, with consent of Canal Board.

Chapter 314, 1889. Permit by Superintendent of Public Workts granted to railroad to be built along Genesee River feeder.

Chapter 100, 1889. Lift-bridge to be built at Caledonia avenue, Rochester; built 1891.

1890. Locks lengthened, 23, 24, 25, 26, 65, 66.

Chapter 314, 1890. City of Syracuse to take water from Skaneateles lake.

1891. Locks lengthened, 40, 41, 42, 43, 46.

1891. Canal improvement bill failed to pass.

Chapter 69, 1891. Swing-bridge to be built at Schuyler street, Utica.

Chapter 82, 1891. Bridge to be built at Tonawanda, Delaware avenue.

Chapter 77, 1891. Lift-bridge to be built at Church street, Schenectady.

Chapter 113, 1891. Moyer creek to be improved.

Chapter 138, 1891. Lift-bridge to be built at Rowe street, Rochester.

Chapter 239, 1891. Lift-bridge to be built at Nineteenth street, West Troy.

Chapter 341, 1891. Lift-bridge to be built at Genesee street, Utica.

BUFFALO AND BLACK ROCK HARBOR.

Chapter 104, 1819. Canal Commissioners to examine entrance to Buffalo creek and direct measures of improving for canal purposes.

Comptroller to lend $12,000 to certain parties to construct harbor.

1821. Canal Commissioners made surveys for harbor at Black Rock and report by Geddes for harbor and ship-lock.

Chapter 251, 1822. If entrance to Buffalo creek is deepened to eight feet water, Canal Commissioners to pay all expenses of harbor company, which is to release to State.

Canal Commissioners to contract for construction of harbor with eight feet water from head of Bird island to Squaw island, if it would cost less than canal along shore.

Chapter 99, 1823. Time for completion of harbor extended to December 1, 1824.

1823. Mole to be built eighteen feet wide from Bird island to Squaw island, 530 rods.

1825. Erie canal completed to connections with Black Rock harbor at dam at head of Squaw island.

1839. Soundings taken for ship-lock at head of Squaw island.

1842. Ship-lock at Black Rock completed.

Chapter 234, 1849. Canal Board to make changes in Erie basin if city of Buffalo deed necessary land to State by city of Buffalo.

Pier 2,244 feet long, basin 2,000x800 feet, ten feet water.

1850. Sea wall built at Buffalo.

1852. Ship-lock rebuilt at Black Rock, 200 feet by thirty-six feet, with four feet lift.

Chapter 326, 1855. Canal Commissioners to dredge Black Rock harbor to original depth.

1862. Erie basin breakwater completed.

1862. Jetty pier completed.

Chapter 131, 1863. Canal Board to pay for work done on Jetty pier.

Chapter 40, 1863. Canal Board to accept Clark and Skinner canal from city.

Chapter 682, 1865. Swing-bridge to be built at Ferry street; built 1868.

Chapter 374, 1868. United States to remove 212 feet from end of Erie basin breakwater.

September 5, 1871. Pier to be built between canal and Black Rock harbor, 120 feet from tow-path.

1877. 10,455 feet completed of division pier; 397 feet not done.

Chapter 77, 1885. Canal from Ferry to Hudson street to be protected from lake encroachment.

1885. Buffalo trunk sewer completed.

CHAMPLAIN CANAL.

Chapter 40, 1792. Northern Inland Lock Navigation Company incorporated to open navigation from Hudson river to Lake Champlain.

Chapter 8, 1792. Locks to be seventy feet by ten feet, with two feet draft boat.

Chapter 40, 1796. Northern Inland Lock Navigation Company to examine between Albany and Meadow creek, north of Troy, and from Meadow creek to Mill creek, where canal is to begin; State to pay three-fourths cost if six feet navigation can be obtained at cost of £6,000.

1814. Commissioners, under joint resolution, propose a canal from the Hudson to Lake Champlain.

1816. Report from joint committee urged speedy opening of route from Hudson to Lake Champlain.

Chapter 237, 1816. Commissioners appointed to adopt measures to effect communication by canal between Hudson river and Lake Erie and Champlain.

Chapter 262, 1817. Lands to be taxed twenty-five miles on each side of canal to raise funds for construction.

July 15, 1817. Commissioners fixed dimensions of Champlain canal thirty feet surface, twenty feet bottom, three feet water, locks seventy-five feet by ten feet.

January 31, 1818. Size of canal changed to same as Erie, forty feet surface, twenty-five feet bottom, four feet water, locks ninety-five feet by fifteen feet.

December 1818. Twelve miles of canal completed.

November 24, 1819. Canal opened from Fort Edward to Lake Champlain.

1820. Canal opened from Fort Edward to Fort Miller.

Chapter 78, 1821. Canal Commissioners to take possession of lock and dam at Troy and vest title in the State.

1821. Survey for Glens Falls feeder made and approved.

Chapter 163, 1822. Glens Falls feeder to be made navigable.

1822. Canal completed and open from Lake Champlain to Waterford.

1823. Canal completed from Lake Champlain to Junction, nine miles north of Albany — sixty-four miles, forty feet surface, twenty-eight feet bottom, four feet water.

1823. Water let in Glens Falls feeder to Sandy Hill.

1824. Troy dam and lock completed; lock 130 by twenty-two by nine feet.

1826. Canal substituted for river navigation from Fort Edward to Fort Miller and opened in 1827.

1832. Hutchison's canal maps completed.

1829. Glens Falls feeder completed; seven miles long; surface. thirty feet; water, four feet; locks, thirteen; ninety-seven by fourteen, lockage 132 feet.

Chapter 453, 1836. Glens Falls feeder to be enlarged and locks built of stone.

1839. Completed twelve stone locks and enlargement of feeder.

Chapter 329, 1854. Locks to be enlarged to same size as Erie (110 by eighteen).

1854. Constitution, article 7, section 3. Champlain locks to be enlarged; adopted February fifteen.

1858. Whitehall locks enlarged.

Chapter 213, 1860. Canal to be improved to five feet water and thirty-five feet bottom width.

1861. Estimate to enlarge locks for gun-boats, 160 feet by twenty-five feet.

1863. Lock 17 completed and S guard-lock, Cohoes.

1864. Fort Edward lock completed.

Chapter 186, 1864. Canal and feeder to be enlarged to five feet water and thirty-five feet bottom; leaks in feeder to be stopped.

Chapter 472, 1865. Survey to be made for slack water navigation, Waterford to Fort Edward.

Chapter 33, 1866. Survey and estimate to be made for slack water navigation, from Waterford to Fort Edward, with stone dams and locks 225 feet by twenty-five feet; also for enlarged canal, seven feet water and locks 225 feet by twenty-five feet, from Troy to Whitehall.

Chapter 33, 1866. Survey to be made of Hudson river tide-water to Fort Edward.

1866. Survey to be made of canal tide-water to Lake Champlain.

1867. Plans and estimates on 33, 1866, submitted to Canal Board.

1868. Forty-five miles canal improved to thirty-five feet bottom and five feet water; seventeen locks enlarged to 110 feet by eighteen feet.

Chapter 715, 1868. Big level to be cut off Glens Falls feeder lock.

1869. Bevels removed from one side of locks in feeder.

1870. Hewitt's lock complete, 110 feet by eighteen feet.

1870. Guard-lock at head of Glens Falls feeder completed.

1871. Flynn's lock completed.

1871. Canal deepening to five feet water completed.

Chapter 788, 1870. Canal to be enlarged to fifty-eight feet surface, forty-four feet bottom and seven feet water.

1870. Estimate made for enlargement by 788, 1870.

Chapter 778, 1871. Troy dam to be relet within thirty days.

1872. Stone dam at Cohoes completed.

1872. Enlargement under 788, 1870, commenced.

1873. Enlargement stopped for want of funds.

1874. Cohoes locks and Waterford locks, Wood creek locks completed.

1874. Leakage from Glens Falls feeder, 10,500 cubic feet per minute out of 28,800.

Chapter 399, 1874. Resurvey to be made for enlargement.

1875. Resurvey and revised plans completed, sixty-four and nineteen-hundredths miles.

Chapter 185, 1876. Canal to be made six feet depth.

1877. Lock No. 6 completed; all locks are enlarged to 110 feet by eighteen feet.

Chapter 202, 1878. Canal to be made six feet depth.

Chapter 258, 1880. Canal to be made six feet depth.

1881. Estimate to complete canal forty-four feet bottom and six feet water; twenty-three locks, 110 feet by eighteen feet on canal; lockage 200.25 feet; three locks, 110 feet by eighteen feet on West Troy side-cut; lockage 34.70.

Fourteen locks, 100 feet by fifteen feet, on Glens Falls feeder; lockage 132 feet.

No. 11 lock, 110 feet by eighteen feet, on Glens Falls feeder.

Sloop-lock at Troy dam, 122 feet by thirty feet.

Chapter 97, 1882. Canal and feeder to be made six feet deep.

Leakage of Glens Falls feeder found to be 12,120 cubic feet per minute, out of 24,360 cubic feet per minute.

Chapter 301, 1884. Canal and feeder to be made six feet deep.

1887. All enlargement to be made forty-four feet bottom and six feet water.

1891. Sixteen miles are now improved to forty-four feet bottom and six feet water since 1884.

Chapter 366, 1886. Lift-bridge to be built at Mechanicville; built 1887.

Chapter 320, 1888. Lift-bridge to be built at Broad street, Waterford; built in 1891.

OSWEGO CANAL.

June 11, 1808. J. Geddes instructed to examine a canal route from Oneida lake to Lake Ontario.

January 20, 1809. Report that Salmon creek route is not feasible. Report Oneida lake to Seneca river, eighteen miles, fall twelve and one-half feet.

Three River Point to Oswego, twenty-four miles, fall 111 1-2 feet.

April 13, 1818. Joint resolution directed survey of Oswego river to Three River Point and Seneca river to Onondaga lake.

January 7, 1820. Report of O. S. Bates on survey for Oswego canal, Salina to Oswego, by Seneca and Oswego rivers; fall, Onondaga lake to Lake Ontario, 118.92 feet in thirty-one and one-half miles.

Chapter 205, 1823. Canal Commissioners to make survey of Oswego river from head of falls to Lake Ontario.

Chapter 241, 1823. Oswego Canal Company incorporated.

Chapter 279, 1824. Canal Commissioners authorized to improve navigation of Oswego river.

Chapter 272, 1825. Money provided to build canal.

1826. River improvement from Oneida lake to Three River Point completed; three dams across river with locks.

December 10, 1828. Oswego canal completed, 19.7 miles.

Slack water navigation, 18.56 miles canal, 123 feet, lockage eighteen feet, locks ninety feet by fifteen feet; six guard locks, ninety feet by seventeen feet; canal surface forty-one feet; water four feet.

1834. Hutchison's maps completed and filed in Comptroller's office.

Chapter 114, 1892. Stop law; all work on canal stopped except to preserve.

Chapter 128, 1845. Canal Commissioners to take charge of Liverpool side-cut.

Chapter 262, 1847. Oswego canal locks to be enlarged to 110 feet by eighteen feet.

Chapter 214, 1849. Oswego canal locks to be enlarged to 110 feet by eighteen feet.

1850. Estimate for fifty-two-foot bottom and seven feet water.

1852. Contracts let for completion of large locks.

Chapter 620, 1853. Oswego canal to be improved.

1853. Nine enlarged locks completed.

1854. Article VII, Constitution, section 3. Oswego canal to be enlarged.

1854. Thirteen enlarged locks completed and in use.

Chapter 329, 1854. Oswego canal to be enlarged.

1855. Seventeen locks and four guard-locks enlarged.

October 14, 1856. Work suspended from want of funds.

1856. Phoenix dam raised four feet two inches.

1859. Twenty-three miles enlargement completed.

Chapter 213, 1860. Bevels to be cut from enlarged locks, and bridges to be raised to twelve feet above surface water.

1861. Dam at Phoenix raised one foot three inches to seven feet above canal bottom.

1862. Mud lock rebuilt.

Chapter 169, 1862. Enlargement declared complete; thirty-eight miles, eighteen locks, 110 feet by eighteen feet, and five guard-locks, 110 feet by twenty-one feet, 154.85 lockage, seventy feet surface, fifty-six feet bottom, seven feet water.

Chapter 311, 1863. Estimate to be made for gun-boat locks 225 feet by twenty-six feet.

1864. Estimate made under chapter 311, 1863.

Chapter 475, 1864. Phoenix dam and Horse Shoe dam to be rebuilt.

Chapter 470, 1865. Dams on Oswego river to be rebuilt in stone.

1866. Phoenix and Oswego Falls dams rebuilt in stone.

1868. Braddock's rapids dam rebuilt in stone.

1871. Minetto dam rebuilt in stone.

1874. High dam rebuilt in stone.

Chapter 646, 1886. Locks on Oswego canal to be lengthened to 220 feet by eighteen feet.

1887. Locks 5 and 6 and guard-lock 1 lengthened.

1888. Lock 7 and guard-lock 4 lengthened.

1889. Lock 11 and guard-lock 3 lengthened.

1890. Locks 9 and 10 lengthened.

1890. Locks 8 and 12 lengthened.

SENECA RIVER IMPROVEMENT AND BALDWINSVILLE CANAL.

Chapter 54, 1809. J. C. Baldwin, authorized to build dam seven and one-half feet high at McHenry's reef, Seneca river, with lock seventy-seven and one-half feet by twelve feet for boats drawing two feet water. To collect tolls and use surplus water for twenty years.

Chapter 252, 1817. Geddes appointed commissioner to report on lock and dams.

Chapter 40, 1822. Onondaga lake to be lowered two feet by Canal Commissioners.

Chapter 168, 1824. Canal Commissioners to survey Seneca river, Jack's reef to Cayuga lake, for drainage of Cayuga marshes.

Chapter 208, 1825. Canal Commissioners appointed, for drainage of Cayuga marshes, to make map showing lands benefited.

Chapter 192, 1827. Right, under 54, 1809, extended twenty-one years to S. W. and H. Baldwin, but lock only to be built if required by Canal Board.

1829. Channel around Jack's reef completed, 4,200 feet long, forty feet wide, lowers water five feet at Cross lake and two feet at Montezuma.

March 18, 1831. Canal Board having required building of lock at dam, the work was completed under direction of Canal Commissioner, lock ninety by fifteen; ten feet lift and canal three-fourths of a mile long.

Chapter 303, 1836. Canal Commissioner to construct towing-path from Mud lock to Baldwinsville.

Chapter 443, 1836. Canal Commissioners to report on practicability of improving Seneca river for steamboat navigation; plan, sixty feet by four and one-half feet deep.

Chapter 306, 1838. Canal Commissioners may spend $15,000 on Seneca towing-path.

1839. Towing-path completed to Baldwinsville, five and three-fourth miles.

Chapter 183, 1841. Canal Commissioners to excavate outlet to Onondaga lake, to reduce lake to level of river.

1849. Extension refused to Baldwin, and bill reported to take possession of lock and canal at Baldwinsville.

Chapter 21, 1850. Right under 54, 1809, extended thirty days.

Chapter 99, 1850. Right under 54, 1809, extended thirty days.

Chapter 153, 1850. Canal Commissioners to take possession of dam, canal and lock at Baldwinsville, and to extend navigation to deep water above dam, same as Oswego canal. Right under 54, 1809, extended until State acquires all rights.

Monuments to be set to fix height of dam which is not to be raised any higher.

1851. Stone monuments set to fix height of dam.

Chapter 503, 1851. Commissioners appointed to examine Cayuga marshes and Seneca river for drainage.

Chapter 535, 1851. Bars at foot of Cayuga lake to be removed.

December 31, 1851. Report, G. Geddes, on drainage of Cayuga marshes.

Cayuga lake to Montezuma, 6.8 miles, 2.593 feet fall.

Mosquito point to Montezuma, 15.6 miles, 4.495 feet fall.

Cross lake to Montezuma, 30.2 miles, 5.890 feet fall.

Foot Jack's reef to Montezuma, 33.8 miles, 11.139 feet fall.

Top Baldwinsville dam to Montezuma, 42.1 miles, 11.967 feet fall.

Top Baldwinsville dam to Montezuma, as fixed by monument, 12.645 feet fall.

Benches made at Cayuga bridge.

1853. Guard-lock at head of Baldwinsville canal completed, and navigation extended to Jack's reef, 11.75 miles.

Chapter 333, 1854. Baldwinsville canal placed under Canal Board control, dam 385 feet long, seven and one-half feet high, 353 feet spillway.

1857. Jacks Reef cut through which lowered Cross lake four feet.

1857. Erie Canal aqueduct and bank built across marshes and river.

Chapter 179, 1858. Canal Commissioners to remove obstructions in Seneca river at junction of Cayuga and Seneca canal.

Chapter 479, 1863. Location of Baldwinsville canal changed.

1863. Baldwinsville lock rebuilt.

1866. Guard-lock at head of canal rebuilt in stone.

Chapter 108, 1868. Bridge to be built over New Onondaga outlet.

Chapter 677, 1869. Baldwinsville dam to be rebuilt in stone when necessary.

1869. Iron bridge built at Baldwinsville.

1870. Seventy-two thousand three hundred and fifty dollars awarded; estimate of $300,000 to complete dredging.

1870. Bars removed by dredging between Jacks Reef and Montezuma.

Chapter 767, 1870. Appropriation for rebuilding dam.

Chapter 827, 1872. Flush boards may be placed on dam up to height fixed by monuments.

1888. Towpath from Baldwinsville to Jacks Reef abandoned by disuse.

ONEIDA LAKE CANAL AND RIVER IMPROVEMENT.

June 11, 1808. J. Geddes instructed to examine Oneida river for canal.

January 20, 1809. Report, Oneida lake to Seneca river eighteen miles, fall, twelve and one-half feet.

Chapter 298, 1824. S. Jewett may construct wing dam at Cauchdenia reef.

1827. Petitions for construction.

Chapter 229, 1828. Canal commissioners to lower Oneida lake; James Porter to construct dam and lock at Cauchanoy; S. C. Schaeppel to construct dam and lock at Oak Orchard.

Chapter 290-328. Canal Commissioners to lower Oneida lake two feet.

January 26, 1830. Childs' report, Oneida river, nineteen and one-fourth miles, fall nine and six-tenths feet.

Chapter 333, 1829. Canal Commissioners to remove dam at Cauchanoy to lower Oneida lake to former level.

January 19, 1831. Petition for incorporation of Oneida Lake Canal Company, three miles and fifty-one feet lockage.

Chapter 53, 1832. Oneida Lake Canal Company incorporated to construct canal from Erie canal to Oneida lake.

Chapter 284, 1838. Canal Commissioners to examine Oneida and report cost of improvement by locks and short canal for four and one-half feet water.

January 15, 1839. Report made by O. W. Childs.

Chapter 284, 1839. Canal Commissioners to improve Oneida river for steamboat navigation.

Chapter 258, 1840. Oneida Lake canal purchased for $50,000.

1841. Canal transferred to State.

Chapter 114, 1842. Stop law; all work stopped.

Chapter 325, 1846. Appropriations to preserve work on Oneida river.

Chapter 261, 1847. Appropriation to complete Oneida river improvement.

Chapter 46, 1860. Locks to be rebuilt same size as Frie.

Chapter 486, 1862. Estimate to be made of cost of enlarging locks.

April 15, 1863. Report recommending building new line of canal; present canal three and three-fourths miles to Wood creek and two and one-fourth miles along creek to lake; lockage sixty feet; new line, Durhamville to lake, four miles.

Chapter 626, 1865. Settlement to be made with contractor on locks abandoned.

Chapter 776, 1866. Canal Commissioners to take charge of dam at Cauchanoy.

1866. Draw-bridge at Oak Orchard built.

Chapter 930, 1867. Locks to be rebuilt on new location.

December 18, 1867. New canal five and thirty-hundredths miles placed under contract.

1870. New locks finished; section two completed; rest three-fourths done.

October 19, 1873. Work of completion placed under contract.

1877. Canal completed, five feet water.

October 24, 1877. Canal closed by break.

July 1, 1878. Canal again opened, but closed by break again; never opened again.

1879. Superintendent of Public Works recommends abandonment of Oneida canal.

Chapter 428, 1887. Lands taken for new Oneida Lake canal released to parties from whom acquired.

CAYUGA AND SENECA CANAL.

Chapter 144, 1813. Seneca Lock Navigation Company incorporated to improve navigation between Seneca and Cayuga lakes.

1818. Locks at Seneca Falls completed and boat passed from Schenectady.

Chapter 168, 1820. Canal Commissioners to examine Seneca lake outlet.

Chapter 271, 1825. Canal Commissioners to construct canal from Montezuma to Seneca lake.

May 13, 1827. Work on canal relet.

1828. Canal completed and navigation opened November fifteenth; Montezuma to Seneca lake twenty-three miles, including two-miles' feeder; eleven locks ninety by fifteen, with forty feet surface, four feet water; Seneca Lock Navigation Company was paid $53,603.53.

Chapter 119, 1828. Canal Commissioners directed to construct canal from Cayuga and Seneca to East Cayuga village.

1828. Cayuga inlet resurveyed and put under contract.

Chapter 290, 1820. Canal Commissioners to lower Seneca lake two feet by deepening canal; appraisers appointed.

1829. Cayuga inlet work completed.

Chapter 360, 1829. Canal Commissioners to lower Seneca lake to level of outlet, one-half mile below foot of lake; inlet to be deepened eighteen inches, thirty-six feet wide.

1829. Canal completed twenty-one miles and two miles side cut, eleven locks; seventy-three lockage, seven feet in side cut; surface forty feet, water four feet, locks ninety by fifteen feet.

1834. Hutchison maps filed.

Chapter 453, 1836. Canal Commissioners to rebuild locks same width as enlarged Erie.

April 11, 1839. Canal Board reported in favor of enlargement.

Chapter 302, 1840. Canal Commissioners to cut channel from northeast bend of lake to canal.

Chapter 212, 1841. Channel to be made navigable.

Chapter 116, 1842. Stop law. All work stopped.

Chapter 313, 1844. Canal Commissioners to lower lake level one foot.

Chapter 251, 1847. Canal Commissioners to improve Cayuga inlet for vessels drawing five feet water.

Chapter 348, 1847. Canal Commissioners may enlarge locks to size of Erie locks when necessary to rebuild.

July 25, 1848. Canal Board adopted plans for locks size of Erie enlarged.

1848. Enlargement of locks commenced.

Chapter 213, 1849. Canal Commissioners may construct independent canal from lock 9 at Seneca Falls to Montezuma level.

1850. Estimate made under 213, 1849.

1850. Under concurrent resolution Canal Commissioners report that enlargement of Cayuga and Seneca was not needed.

Chapter 246, 1852. Canal Commissioners to take charge of Cayuga inlet.

Chapter 329, 1854. Commissioners of Canal Fund to borrow money for completion.

1854. Art. VII, Constitution, sec. 3. Canal to be enlarged.

1854. Lock at Seneca level removed and level extended to Waterloo.

1854. Eight locks enlarged.

1855. Eleven locks enlarged, Montezuma to Seneca, 20.71 miles; branch to Cayuga, 2.06 miles; total, 22.77 miles.

1858. Old lock between Waterloo and Seneca Falls removed.

Chapter 479, 1857. Canal from Waterloo to Seneca lake to be deepened to nine feet.

Chapter 213, 1860. Bevels to be cut off enlarged locks, and bridge raised to twelve feet above surface.

1860. 409 miles enlarged to seven feet water.

September 30, 1861. 10.59 miles enlarged to seven feet water.

Chapter 169, 1862. All contracts to be closed on September first.

1862. Enlargement complete.

1862. Cayuga inlet dredged to seven feet water, Oswego street to lake.

1863. Channel at foot of Seneca lake completed.

1864. Pier at Seneca completed.

Chapter 752, 1867. State dam at Waterloo to be raised to the original height but not to raise lake above natural height.

Chapter 915, 1871. Swing-bridge to be built at State street, Ithaca, over inlet.

1875. Constitution, art. VII, sec. 6. Cayuga and Seneca never to be sold.

Chapter 325, 1888. Old Bear race at Waterloo to be improved.

Chapter 291, 1888. Swing-bridge to be built at Buffalo street, Ithaca; built 1889.

February 8, 1889. Work on Bear race stopped by injunction.

1889. Piers at Ithaca and at Geneva rebuilt.

BLACK RIVER CANAL.

Chapter 236, 1825. Canal Commissioners to survey from Rome by way of Black river to Ogdensburg.

February 3, 1827. Petitions presented for construction of canal.

1828. Conger survey made for a company, twenty and one-half miles; eleven locks, seventy-three and one-half lockage.

March 24, 1829. Concurrent resolution; Canal Commissioners to survey for canal from Rome to High Falls, and for river improvement to Carthage.

February 28, 1831. Report of Hutchison on survey; rise and fall, Rome to Black river, 1,078 feet; thirty-six miles to High Falls and forty miles to Carthage; size twenty feet bottom, thirty-six feet surface, six feet water. To have inclined planes and locks.

Chapter 174, 1832. Black River Company, incorporated to connect by railroad or canal, Rome or Herkimer with Ogdensburg, Cape St. Vincent and Sackett's Harbor, and to improve Black river from High Falls to Carthage.

Chapter 139, 1834. Canal Commissioners to survey canal route from High Falls to Erie canal, and river improvement High Falls to Carthage.

1834. Survey of J. B. Jervis; canal and feeder forty-six and three-fourths miles, 1,083 1-2 lockage; summit above Erie 696 1-2 fall to below High Falls, 387 feet.

Chapter 157, 1836. Canal Commissioners to construct canal from High Falls to Rome, also feeder to Boonville, and to improve Black river from High Falls to Carthage.

1837. Fall, High Falls to Otter creek, eleven miles four and one-half feet, to creek bridge nine and one-half miles three and two-tenths feet, to Carthage twenty-two miles one and fifty-five hundredths feet.

1838. Canal work let from Lansing kill to High Falls; Black river improvement, commenced by jetties and piers.

Chapter 321, 1839. Canal Commissioners to survey for extension from Carthage to Ogdensburg.

February 21, 1840. Survey by Broadhead to Frenches creek on the St. Lawrence.

Chapter 114, 1842. Stop law; all work stopped.

Chapter 260, 1847. Appropriation for canal construction resumed.

1848. Dam completed for Forestport pond.

June, 1848. Boonville feeder completed, four feet water, 10.29 miles.

November, 1849. Thirty-five miles completed.

1850. Report of Tenny on damages for water taken from Black river.

1850. Dam built at Woodhull lake to raise water five feet.

Chapter 485, 1851. Balance of revenue to be applied to completion.

October, 1851. Boonville to Port Leyden completed; ninety-four locks completed and thirty-one miles canal.

1851. Surveys made for reservoir and plan for Woodhull, North Branch and South branch and Marsh, adopted by Canal Board.

Surveys made for forty-two and one-half miles Black river improvement.

Delta feeder and dams at High Falls and Carthage.

1851. Monuments set up for height of Baldwinsville dam.

Chapter 181, 1851. Canal Commissioners to make surveys of lakes at head of Black river, and of Moose and Beaver rivers, and to erect dams to supply Black river with same amount of water taken by canal.

1852. Contract let for completion under 485, 1851.

Chapter 270, 1852. Contracts to be filed in Canal Department.

Chapter 473, 1857. Repeal of 270, 1852.

1853. Ninety-seven locks thirty-three and thirty-three hundredths miles canal, ten twenty-nine hundredths feeder, complete.

Chapter 329, 1854. Commissioners of canal fund to borrow money for completion.

1854. Article VII, Constitution, § 3. Canal to be completed.

1855. Forty-seven and fifty-hundredths miles completed.

1855. South Branch lake and Chub lake adapted for reservoirs.

1856. Entire length in use, Rome to Black river at High Falls, thirty-five miles, 109 locks, ninety feet by fifteen feet, lockage, 1,092 feet.

September 3, 1857. Canal Board changed plan of Black river improvement from piers and wing dams to lock and dam at Otter creek.

Chapter 245, 1857. Time for presentation of claims for damages on account of water of Black river taken for canal, extended one year.

Chapter 428, 1857. Bridge at Tiffany's to have draw.

Chapter 185, 1859. Black river improvement and all reservoirs made part of section 2, Black River canal.

1858. Main line of canal completed.

1859. Dam and lock at Otter creek put under contract, also Woodhull and South Branch reservoirs.

October 10, 1859. Contracts let for river improvement, High Falls to Carthage for five feet water, sixty feet channel.

1859. Woodhull reservoir completed.

1859. Guard-lock at head of Delta feeder completed.

1860. Three reservoirs in use, North Branch, 423 acres.

1860. South Branch, 518 acres; Woodhull, 1,236 acres.

1860. Delta feeder completed.

1861. Lock and dam at Otter creek completed; twenty-two and one-half miles slack-water navigation, Carthage to Beeches bridge, ten miles dredged to Otter creek and ten miles slack-water navigation to Lyons Falls; lock, 160 by thirty, four and one-half lift.

Chapter 119, 1862. All contracts to be closed first September next.

Chapter 151, 1864. Lock to be built between Otter creek and Carthage.

Chapter 174, 1864. Canal Commissioners to rebuilt bridge at Lyons Falls over Black river.

Tolls to be collected on Moose river.

1865. Canal Board adopted location of lock, three miles above Beeches bridge, which is placed under contract.

Chapter 602, 1866. State to maintain bridges at Illingsworth and at Beeches.

1868. Dam and lock three miles above Beeches bridge, completed; 160 feet by thirty feet, four and one-half feet.

Chapter 868, 1869. Bridge to be built over Beaver river.

1870. First level at Rome improved to size of Erie.

Chapter 784, 1872. Illingsworth and Beeches bridge to be maintained by State.

1872. Sand Lake reservoir completed.

Chapter 850, 1872. Dam to be constructed in Moose river at Old Forge, foot of Fulton chain.

Chapter 499, 1875. Canal to be examined and report made as to abandonment.

Chapter 382, 1876. Commission appointed to report what disposition should be made of canal.

March 1, 1876. Black River canal put on middle division.

1880. Surveys of Canachagala, Twin lakes and White lakes and dam built at 2 Bisby.

1881. Canachagala, Bisby and White and Twin lake reservoirs completed.

Chapter 452, 1883. Reservoir to be constructed above Forestport for $20,000.

Constitution, 1882. Article 7, section 6. Legislature not to sell Black River canal.

1883. Examinations made for Beaver river reservoir at Stillwater and plans prepared for Forestport reservoir.

Chapter 253, 1885. Tow-path to be made along Beaver river.

1884. Work commenced on Forestport dam.

1885. Work commenced on Stillwater dam on Beaver river.

Chapter 550, 1886. Wall to be built at Lock street, Rome.

1886. Dam at Stillwater, Beaver river, completed; nine feet six inches above low water, 150 feet spillway, 328,000,000 cubic feet.

1888. Locks 8 and 48 rebuilt.

Chapter 274, 1889. Forestport dam to be built.

1889. Lock 60 rebuilt.

1890. Lock 12 rebuilt.

1891. Lock 1 rebuilt.

Chapter 342, 1891. Forestport reservoir to be cleared.

CHENANGO CANAL.

Chapter 236, 1825. Canal Commissioners to survey for canal from Chenango point up Chenango river through Norwich to Erie canal.

1827. Petitions for construction.

1828. Hutchison's survey, ninety-two and three fourth miles; summit 706 above Erie.

Chapter 72, 1829. Canal Commissioners to construct canal from Binghamton to Utica, size of Erie.

1833. Survey by J. B. Jarvis, for canal 175 miles.

Chapter 32, 1833. Canal Commissioners to construct canal from Binghamton to Erie canal, same size as Erie.

July, 1834. Work commenced at Shelburn.

Chapter 46, 1833. Canal to connect with Erie at Huntington basin, Utica.

October, 1836. Canal completed; ninety-seven miles, forty feet surface, twenty-four feet bottom, four feet water, 116 locks, ninety by fifteen; 1,021 feet lockage.

Chapter 292, 1838. Canal Commissioners to survey for extension of canal from Binghamton to State Line, at Tioga Point.

Chapter 114, 1842. Stop law; all work stopped.

Chapter 88, 1859. Examination to be made of survey for extension.

January 10, 1860. Report on extension, Binghamton to Athens, thirty-eight and forty-eight-hundredths miles.

Chapter 115, 1863. Canal Commissioners to construct extension to Athens.

1863. One hundred and sixteen locks on canal, mostly in bad condition.

Chapter 185, 1864. Locks on extension to be size of Penn. North Branch canal and locks on main canal to be rebuilt of that size, ninety-one feet by sixteen and a half feet.

1865. Ten miles of extension completed.

Chapter 649, 1866. Locks in extension to be size of Penn. North Branch canal, ninety-one feet by sixteen and a half feet.

1866. Thirty miles of extension under contract.

Chapter 98, 1846. Asylum to use surplus water from 5th lock of canal.

Chapter 457, 1859. Asylum to control level above 5th lock for water and ice.

Chapter 564, 1867. Asylum to control levels from 5th lock to 10th lock.

1867. Work suspended on extension; want of funds.

1868. Ten miles of extension completed. Twenty miles under contract. Ten and one-half not contracted.

1870. Work completed; Binghamton to Owego, twenty-two miles; work suspended on extension; want of funds.

Chapter 787, 1872. Canal from Prospect avenue to Susquehanna street, Binghamton, abandoned to city for street.

1872. Fifty locks require rebuilding in main canal.

1872. Dam and guard-lock at Binghamton completed.

Chapter 711, 1873. City of Binghamton may declare part of canal, under 787, 1872, to be a public street.

1873. Work on extension suspended.

Chapter 835, 1873. Binghamton, Dashore and Williamsport railroad to lay track on tow-path of extension south of Susquehanna river.

Chapter 607, 1874. Protection wall to be built from Rock Bottom dam 550 feet up river on north side.

Chapter 499, 1875. Canal to be examined and report made as to abandonment.

Chapter 382, 1876. Commission appointed to report what disposition shall be made of canal.

Chapter 404, 1877. Canal south of Hamilton and also extension to be abandoned on May 1, 1878, but reservoirs and feeders north of Hamilton reserved; Madison brook, Kingsley brook, Woodman's pond, Leland pond reservoirs all reserved.

Chapter 391, 1878. City of Binghamton to use canal in city limits as a street.

Chapter 344, 1878. Canal Commissioner to sell canal, as in 406, 1877.

Chapter 552, 1879. Superintendent of Public Works to sell canal after January 1, 1880.

Chapter 190, 1880. Canal in city of Binghamton released to be used as street.

Chapter 551, 1880. Interest of State south of Hamilton released to occupants of adjoining lands, including extension; in village of Norwich, Oxford and Green released to village.

Chapter 489, 1881. Abandoned canal from Hamilton south released to adjoining owners, including Chenango canal extension.

Chapter 157, 1881. Sales of canal property to be advertised.

Chapter 314, 1881. Stone from locks to be given for Herkimer monument.

Chapter 49, 1882. Material of locks, bridge, etc., to be sold by auction.

Chapter 450, 1883. Canal in city of Utica may be leased to adjoining owners.

Chapter 382, 1884. Canal north of Hamilton to lock 79 released to village of Hamilton, including reservoir of Woodman pond.

Chapter 98, 1884. Canal bank from lock 59 to lock 53 released to Utica, Clinton and Binghamton railroad.

Chapter 482, 1884. Bridges at Columbia and Fayette streets, in Utica, to be rebuilt.

Chapter 90, 1885. Bridges at Columbia and Fayette streets, in Utica, to be lowered or replaced by culverts.

1885. Work completed on Columbia and Fayette street bridges.

Chapter 588, 1887. Abandoned canal from south line Utica to Solsville released to adjoining proprietors, with exception between south end of Utica and Sargeant creek, between locks 23 and 18, and in village of Oriskany Falls.

Chapter 678, 1887. City of Binghamton to use canal lands in city for streets.

Chapter 456, 1887. City of Utica to fill up abandoned canal in city south of Canal street, and to sell the lands for payment.

Chapter 23, 1888. Amendment to 588, 1887.

Chapter 375, 1888. Embankment at Mad brook, Shelburn, to be repaired.

GENESEE VALLEY CANAL.

Chapter 236, 1825. Canal Commissioners to survey for canal from Rochester to Olean, through Genesee valley.

1827. Petitions for construction of canal.

Chapter 215, 1834. Canal Commissioners to survey this year for canal, Rochester to Olean, and side-cut to Dansville.

Chapter 257, 1836. Canal Commissioners to construct canal from Rochester to Mt. Morris, and to Olean and Dansville.

1838. Canal completed from Rochester to the rapids.

October 31, 1838. Sections seventy-six to eighty-six let.

1839. Report of Talcott; reservoirs proposed Oil creek, dam fifty-five feet high; 490 acres; 390,000,000 cubic feet water.

Ischua creek, dam seventy feet high, 575 acres, 588,000,000 cubic feet water.

Chapter 114, 1842. Stop law; all work stopped.

November 1, 1842. Fifty-two miles completed to Dansville.

1843. Brockville reservoir completed.

Chapter 213, 1847. Appropriation to resume work on canal.

Chapter 485, 1851. Balance of revenue to be applied to completion.

1851. Eighty-five miles completed.

1852. Contracts let for completion under 485, 1851.

1852. Seventy-nine locks and eighty-eight miles completed.

Chapter 270, 1852. Contracts to be filed in canal department.

Chapter 473, 1853. Repeal of 270, 1852.

1853. Eighty-three locks, eighty-eight miles canal completed.

Chapter 329, 1854. Commissioners of canal fund to borrow money for completion.

Chapter 331, 1854. Survey to be made for navigable feeder to Wellsville, nineteen miles.

1854. Article VII, Constitution, section 3. Canal to be completed.

1855. Ninety-three miles completed, Rochester to Rockville.

Chapter 149, 1856. Survey and estimate ordered for extension of canal from Olean to Millgrove, seven miles.

Chapter 247, 1857. Canal Commissioners to construct extension of canal, Olean to Millgrove, six and one-half miles.

1857. One hundred and seventeen miles completed.

1857. Extension to Millgrove contracted.

1858. Oil Creek reservoir completed, 470 acres, twenty-five feet average depth, forty-six feet at dam.

1859. Millgrove extension completed to Portville, five miles.

Chapter 169, 1862. All contracts to be closed first September.

1862. Extension to Millgrove, completed, six and one-half miles.

Chapter 342, 1863. Surface of water to be raised three feet in Oil Creek reservoir.

Chapter 170, 1864. Lime lake to be made a reservoir, timber locks to be rebuilt in rubble masonry.

1864. Oil Creek reservoir raised three feet, mean area, 450 acres.

1869. Oil Creek reservoir raised six feet more, 800 acres, average 60,000 by thirty feet.

Chapter 449, 1875. Canals to be examined and report made as to abandonment.

Chapter 382, 1876. Commissioners appointed to report what disposition should be made of canal.

Chapter 404, 1877. Canal to be abandoned September 30, 1878.

Chapter 344, 1878. Canal Commissioners to sell canal as per 414, 1877.

Chapter 522, 1879. Superintendent of Public Works to sell canal after January 1, 1880.

1878. Canal abandoned 1879.

Chapter 326, 1880. Canal between Mt. Morris and Cuba to be sold to railroad for 100 per mile; between Mt. Morris and Rochester to be sold to railroad for $100 per mile; between Cuba and Olean and Millgrove to be sold to railroad for $100 per mile.

From Cuba reservoir to Rockville reservoir reserved.

Also from Allen's Creek feeder to Rochester.

Chapter 593, 1881. Sanitary condition of abandoned canal to be improved in Groveland and Mt. Morris.

Chapter 666, 1881. Water to be removed from abandoned canal in Rochester, and water from Allen's Creek feeder to be carried across river to Genesee River feeder.

Chapter 157, 1881. Sales of canal property to be advertised.

Chapter 166, 1882. Wiscoy Reservoir feeder and Ishua Reservoir feeder, Dansville branch, vested in certain parties.

1883. Ohio basin in Rochester extended up abandoned canal for 500 feet by permit of Superintendent of Public Works.

Chapter 229, 1887. Genesee Valley Canal Railroad Company, to release to city of Rochester canal lands in West avenue.

Chapter 470, 1889. Canal to be drained in Wheatlands and Chili.

Chapter 96, 1890. Canal to be drained in Pine valley and Millport.

CHEMUNG CANAL.

Chapter 125, 1815. Seneca and Susquehanna lock navigation incorporated.

Chapter 135, 1829. Canal Commissioners authorized to construct canal after release to State by Seneca and Susquehanna Lock Navigation Company.

1833. Canal completed four feet water, forty-two surface, fifty-three locks, ninety by fifteen feet, 516 feet lockage.

Watkins to Elmira, twenty-three miles.

Horseheads to Corning feeder, sixteen miles.

Chapter 176, 1840. Canal Commissioners authorized to rebuild the locks.

Chapter 219, 1841. Canal Commissioners authorized to construct canal cut in place of inlet at Seneca lake.

Chapter 34, 1842. Funds to be raised for work under 219, 1841.

Chapter 227, 1854. Canal Board authorized to permit connection of junction canal in Elmira.

Chapter 211, 1858. If Canal Board so decide locks to be enlarged to size of Erie locks after completion of Erie enlargement.

Chapter 232, 1864. Canal Commissioners directed to build timber locks of size of Erie locks (nothing done).

Chapter 515, 1866. Draw-bridge to be built at Watkins.

Chapter 785, 1872. Canal abandoned for one mile in Elmira from Chemung river to Junction canal, to be used by city of Elmira as street only.

Chapter 404, 1877. Chemung canal declared abandoned at end of season of 1878.

1878. Canal finally closed in December.

Chapter 593, 1881. Sanitary condition of abandoned canal to be improved, Havana to Horseheads.

Chapter 482, 1881. Parts of abandoned canal released to certain parties.

Chapter 157, 1881. Sale of canal property to be advertised.

Chapter 105, 1884. Canal to be drained at Horseheads.

Chapter 470, 1885. Canal to be drained at Havana.

Chapter 440, 1886. Slope-wall to be completed at Corning.

Chapter 276, 1886. Lock in Corning to be filled up.

Chapter 169, 1887. Havana level reopened, 4.10 miles.

Chapter 315, 1888. Slope-wall to be completed at Corning.

1890. Swing-bridge at Watkins completed.

1891. Work of reopening lake level completed.

Chapter 300, 1891. Slope-wall at Corning to be completed.

CROOKED LAKE CANAL.

1827. Petitions for construction of canal.

April 19, 1828. Concurrent resolution for survey from Seneca lake to Crooked lake.

Chapter 120, 1829. Canal Commissioners to construct canal, size of Erie.

November 12, 1826. Hutchison's survey, eight miles, twenty-seven locks, 270 feet lockage.

October 10, 1833. Canal completed eight miles, forty feet surface, four feet water, twenty-seven locks ninety by fifteen, 239 feet lockage.

1834. Hutchison's maps completed.

Chapter 276, 1835. Canal Commissioners to deepen upper level two feet six inches and to reconstruct dam to four feet above bottom of lower level.

Chapter 216, 1836. Canal Commissioners may purchase water privileges of Waggoner and Gillet.

Chapter 313, 1844. Canal Commissioners to adapt canal to level of lake lowered one foot.

Chapter 338, 1845. Canal Commissioners to reconstruct locks.

January 1, 1846. Contracts let for rebuilding all locks.

Chapter 325, 1846. Canal Commissioners to reconstruct locks, appropriations resumed.

Chapter 249, 1847. Canal Commissioners to rebuild locks as before.

May 8, 1848. Lock rebuilding completed.

Chapter 218, 1849. Canal Commissioners may rebuild first lock in stone in Seneca lake.

1851. Pier at Seneca lake entrance completed.

1863. New guard-lock constructed at Penn Yan.

1871. Six locks rebuilt.

Chapter 499, 1875. Canal to be examined and report made as to abandonment.

Chapter 382, 1876. Commission appointed to report what disposition should be made of canal.

Chapter 404, 1877. Canal to be abandoned after passage of this act, June fourth.

January 3, 1877. Canal transferred from middle division to western division.

Chapter 344, 1878. Canal Commissioners to sell canal.

Chapter 143, 1878. Commissioners of land office to release banks and prisms of canal to Penn Yan railroad for $100.

Chapter 522, 1879. Superintendent of Public Works to sell canal.

Chapter 157, 1881. Sales of canal property to be advertised.

Chapter 34, 1882. Time for completion of Penn Yan railroad extended and release confirmed.

Chapter 471, 1884. Time for construction of Penn Yan railroad extended five years and release confirmed.

HUDSON RIVER.

Chapter 8, 1792. All dams in Hudson river to have flow-gate and fishways.

Chapter 39, 1797. Pile dykes to be built across Island channel opposite J. L. Whitbeck's mill.

Chapter 11, 1799. Dam built in place of dyke; 39, 1797 approved.

Chapter 20, 1799. Commissioners appointed to improve river between Troy and Lansingburgh; to assess certain property for funds.

Chapter 25, 1800. Commissioners appointed to improve river between Lansingburgh and Waterford and between Troy and Albany; to raise money by lottery.

Chapter 8, 1801. Five thousand dollars to be raised by lottery for river improvement.

Chapter 68, 1801. Ten thousand dollars to be raised by lottery for river improvement.

Chapter 30, 1801. Persons authorized to deepen river from Stillwater to Waterford, but not to remove permanent mill dams.

1804. Gen. Genet proposed canal, Albany to New Baltimore, twelve and one-half miles.

Chapter 61, 1804. Twenty thousand dollars to be raised by lottery for river improvement, Troy and Waterford. Governor to appoint commissioners to improve river below Albany.

Chapter 133, 1810. Thirty thousand dollars to be raised by lottery company for map of river from Troy to Waterford.

Chapter 157, 1812. Trustees of city of Troy to improve river between Albany and Troy and commissioners to turn over all money to them. Commissioners appointed to improve river, Albany to Coeymans.

Chapter 260, 1815. H. Boyd appointed sole commissioner to improve river from Troy to Coeymans.

Chapter 37, 1816. Commissioner appointed in place of H. Boyd, who declined.

Chapter 196, 1817. Dam at Troy to be extended across river and lock built.

Chapter 72, 1818. Commissioners appointed to fill vacancies on improving river, Troy to Waterford.

Chapter 178, 1818. Treasurer to pay to commissioners for improving river, Albany to Coeymans, all unexpended balances of former appropriations.

Chapter 120, 1819. Permanent dam to be erected at Fish House island to east shore.

1819. First hydrographic survey, Troy to New Baltimore, by J. Randall.

Chapter 152, 1819. Commissioners appointed to report plans and estimates for improving navigation on tide-waters of river.

1820. Commissioners advised canal, Albany to New Baltimore.

Chapter 78, 1821. Commissioners for improving navigation to pay all unexpended balances to Canal Commissioners to complete Troy dam and lock, which will be vested to State.

Chapter 250, 1821. Commissioners for improving navigation to have power between point where powers of Troy commissioners end and Coeymans overslaugh.

1823. B. Wright advised canal, Albany to New Baltimore.

1824. Troy dam and lock completed, 114 by twenty-nine and one-half, with nine feet lift.

Chapter 296, 1827. Canal Commissioners to improve river between Troy dam and Coeymans by dredging.

1831. Hydrographic survey, Waterford to New Baltimore, by Colonel DeWitt Clinton.

Chapter 375, 1829. Appropriation to complete dredging machine.

1833. Citizens of Albany petition for a canal, Albany to New Baltimore.

Chapter 240, 1834. Canal Commissioners to make surveys of river from Troy to New Baltimore and also for ship canal from Greenbush to New Baltimore on east side of river, twelve and three-fourth miles, thirty-five feet wide, eighteen feet deep.

Chapter 229, 1835. United States to survey land necessary, new improvements made under act of Congress.

1835. United States engineers advised channel and improvement instead of canal.

Chapter 70, 1836. Albany Tunnel Company incorporated to construct tunnel under river to Van Rensselaer island.

Chapter 29, 1839. Land ceeded to United States for light-house at Esopus.

Chapter 323, 1839. Canal Board to survey canal route up Hudson river from Corinth to Johnsburgh and from Corinth to Northampton.

Chapter 95, 1840. Obstruction near Van Wies point to be removed.

Chapter 390, 1840. Land ceeded to United States for beacon at Tarrytown.

1843. Survey from Troy to New Baltimore by Captain S. W. Hughes.

Chapter 406, 1849. Commissioners appointed to clear channel from head of Glens Falls feeder to Hadley and from Phelps bay up Sacondaga.

Chapter 368, 1852. State Engineer to remove obstructions at Castleton.

1853. W. J. McAlpine reported plan for canal Albany to New Baltimore, surface twenty feet water, two locks, 300 by fifty, 215 by thirty.

Chapter 190, 1853. Albany and New Baltimore Ship Canal and Basin Company incorporated.

Chapter 146, 1856. Hudson River Bridge Company at Albany incorporated.

Chapter 374, 1857. Commissioners appointed to remove obstructions, Troy to New Baltimore.

Chapter 361, 1858. Canal Commissioners to dredge river opposite Troy to eight feet depth.

Chapter 20, 1860. Persons cutting ice in river to erect safety fences.

1861. Coast survey triangulation of river completed.

Chapter 122, 1863. Commissioners appointed to remove obstructions, Troy to New Baltimore.

December 28, 1863. Report of commissioners on dyke at Coeymans 2,940 feet long, at Castleton 3,370 feet long.

1863. Coeymans dyke built, 2,710 feet long, eleven and one-half miles south of Albany.

Chapter 105, 1864. Commissioners appointed with State Engineer to continue improvement of river, Troy to New Baltimore, and to deepen Catskill creek.

Chapter 243, 1864. Location of Hudson river bridge, Albany, changed to 100 feet north of Lumber street and to be twenty feet above ordinary tide water.

February 4, 1864. Report of Commissioners, channel at mean low tide is seven and one-half feet where it was only four feet in 1819.

Jetties at Coeymans and Castleton secure ten feet water. Dykes should not extend above ordinary high tide.

1864. Pixtaway dyke built, 2,907 feet long, five and one-half miles south of Albany.

Chapter 472, 1865. Canal Board to survey for slack water navigation.

1864. Castleton dyke built, 2,960 feet long, nine miles south of Albany.

Chapter 561, 1865. Commissioners with State Engineer appointed to continue improvements from Troy to New Baltimore.

1865. Greenbush dyke built, 3,086 feet long, one-half mile south of Albany.

Chapter 491, 1866. Commissioners with State Engineer appointed to continue improvement, Troy to New Baltimore.

January 16, 1866. Dyke built at Willow island near New Baltimore, 4,507 feet long.

Dyke, 924 feet long, built at Schodack; Cuyler's dyke completed.

Coeymans dyke extended 460 feet.

Loss of tide, Stuyvesant and Albany, eighteen inches, twenty-four miles.

Loss of tide, New York to Stuyvesant, five inches, seventy-eight miles.

Plan of work is for eight feet at low water, from Troy to New Baltimore.

Chapter 549, 1867. Persons cutting ice in river must erect fence four feet high, and if cut extend across river must maintain bridge.

1867. Mills light dyke built, 3,628 feet long, ten miles south of Albany.

Chapter 647, 1867. Commissioners with State Engineer appointed to continue river improvement, Troy to Coxsackie.

1867. New Baltimore dyke built, 6,470 feet long, fourteen miles south of Albany.

February 13, 1867. Report on survey for slack water navigation.

Troy to Fort Edward, locks 225 feet by twenty-five feet, stone dams.

Troy to Fort Edward, 398 miles, rise 116 feet.

Eleven locks and dams, eight feet water, estimate, $2,360,079.

Chapter 412, 1868. Hudson River Bridge Company, to remove bridge over Hudson, at Albany, to foot of Exchange street, and to remove present bridge.

Chapter 332, 1868. Hudson, Highland Suspension Bridge Company, incorporated to erect bridge from Verplanck's point to Butterworth falls.

Chapter 779, 1869. Hudson River Bridge Company may construct another bridge across Hudson between State street and Maiden lane.

Chapter 555, 1870. Canal Commissioners to construct fishways on Troy dam.

Chapter 897, 1871. Poughkeepsie Bridge Company, incorporated.

Chapter 269, 1872. Albany and Greenbush Bridge Company, incorporated.

Chapter 310, 1872. Troy and West Troy Bridge Company, incorporated; Congress street bridge.

Chapter 321, 1872. Troy, Lansingburgh and Cohoes Bridge Company, incorporated.

Chapter 546, 1872. Mechanicville Bridge Company, incorporated.

Chapter 346, 1872. Commissioners with State Engineer appointed to improve river by dredging between Troy and Coxsackie.

1873. Report of Gardner gives river at Albany above mean surface of sea, 4.84.

Chapter 376, 1876. Dumping in river forbidden.

Chapter 204, 1876. State Engineer to improve river, Troy to Coxsackie, to secure five feet at mean low water below Troy sloop lock.

Six feet depth by 125 feet wide between Troy and Albany.

Ten feet depth by 125 feet at Coeymans and New Baltimore.

January 31, 1877. Lieutenant Willard reports at mean low water depths, Bogart light 8.6, overslaugh bar 8.1, Coeymans 8.2, New Baltimore 8.8.

Chapter 411, 1877. State Engineer to improve river, Troy to Coxsackie.

To secure State dam to Troy bridge, five feet water, sixty feet wide.

To lower Albany bridge, seven feet water, 125 feet wide.

To Coxsackie, ten feet water, 150 feet wide.

1877. Two hundred and twenty-seven thousand cubic yards dredge under 204-78 and 411-77.

1877. Concurrent resolution to have pier line established, Troy to Hudson.

Chapter 205, 1878. State Engineer to improve river, Troy to Coxsackie, same as pier 411-1877.

Chapter 39, 1878. Time for completion of Poughkeepsie bridge extended to 1881.

1878. Two hundred and thirteen thousand cubic yards dredged out: channel is nine feet to Albany.

Chapter 456, 1879. Dumping may be done on land under water granted and back of dykes for river improvement.

Chapter 388, 1879. Adjoining proprietors have first right to cut ice to center of river.

Chapter 106, 1879. State Engineer to improve river, Troy to Coxsackie.

To secure State dam to Troy railroad bridge, sixty feet wide, five feet water.

To lower Albany railroad bridge, 125 feet wide, eight feet water.

Coxsackie, 150 feet wide, ten feet water.

1879. One hundred and fourteen thousand cubic yards dredged.

Chapter 50, 1880. Time for completion of Poughkeepsie bridge extended to 1883.

Chapter 51, 1880. State Engineer to improve river, Troy to Coxsackie, same as per 106-1879.

Chapter 541, 1880. Lights to be maintained on all Hudson river swing-bridges.

Chapter 230, 1881. State Engineer to improve river, Troy to Coxsackie, as per 106-1879, also Catskill creek.

Chapter 372, 1882. State Engineer to improve river, Troy to Coxsackie, as per 106-1879, also Catskill creek and West Troy side-cut.

Chapter 77, 1882. Time for completion of Poughkeepsie bridge extended to 1888.

Chapter 451, 1883. Superintendent of Public Works to improve river, Troy to Coxsackie.

To secure railroad bridge at Troy, to lower railroad bridge, Albany, 125 feet wide, eight feet water.

Coxsackie, 150 feet wide, ten feet water.

Also Catskill creek.

Chapter 223, 1883. Land ceded to the United States for lighthouses at Oriskimer, Pt., and at Narrow Channel.

Chapter 541, 1884. Governor to appoint commission to report on storing headquarters of Hudson river.

Chapter 110, 1884. Superintendent of Public Works to improve river, Troy to Coxsackie, as per 451-1883.

Chapter 273, 1884. Land commissioners to convey to United States lands necessary for lighthouses on Hudson river.

1884. One hundred and fifteen thousand cubic yards dredged from river.

Chapter 210, 1885. Superintendent of Public Works to improve river, Troy to Coxsackie.

To secure Troy dam to Troy railroad bridge, eighty feet wide, six feet water.

Lower Albany railroad bridge, 125 feet wide, eight feet water.

Coxsackie, 150 feet, ten feet water.

Also Saugerties creek.

1885. One hundred and ninety-nine thousand cubic yards dredged from river.

Chapter 172, 1886. Superintendent of Public Works to improve river, Troy to Coxsackie, as per 210-1885.

1886. One hundred and four thousand cubic yards dredged from river; dyke built at New Baltimore, 1,000 feet long.

Chapter 162, 1887. Superintendent of Public Works to improve river, Troy to Coxsackie, as per 210, 1885.

1887. One hundred and fourteen thousand cubic yards dredged from river.

Chapter 512, 1887. Fishway to be constructed in Troy dam.

Chapter 173, 1888. Superintendent of Public Works to improve river, Troy to Coxsackie; to secure from Troy dam to Troy railroad bridge, eighty feet wide, six feet water; lower railroad bridge, Albany, 140 feet wide, ten feet water; Coxsackie, 175 feet wide, eleven feet water.

1888. One hundred and ninety-five thousand cubic yards dredged from river.

Chapter 278, 1889. Mole to be constructed at McCabes, Houghtaling island.

Chapter 106, 1889. Superintendent of Public Works to improve river, Troy to Coxsackie, as per 173, 1888.

1889. One hundred and seventy-six thousand one hundred cubic yards dredged from river.

March 25, 1890. Pier lines approved by Secretary of War, Troy to New Baltimore.

Chapter 501, 1890. Troy and Breaker Island Bridge Company incorporated.

Chapter 204, 1890. Superintendent of Public Works to improve river, Troy to Coxsackie, thirty-two miles, as per 173, 1880.

1890. Eighty-five thousand one hundred cubic yards dredged from river.

1891. No appropriation by State; United States took charge of river.

TABLE OF DISTANCES ALONG THE ERIE CANAL.

NAMES OF PLACES.	No. of bridge.	DISTANCE IN MILES.		
		Place to place.	From Albany.	From Commercial street, Buffalo.
EASTERN DIVISION.				
Lock 1, Albany*	....	....	......	350.60
Lock 2, "	....	1.24	1.24	349.36
Port Schuyler side cut junction	14	3.36	4.60	346.00
Union street, West Troy, side cut junction	20	1.21	5.81	344.79
Change bridge, junction Champlain canal	22	0.62	6.43	344.17
Lock 3, West Troy	....	0.05	6.48	344.12
Lock 4, Cohoes	....	0.32	6.80	343.80
Lock 5, "	....	0.27	7.06	343.53
Lock 6, "	....	0.21	7.28	343.32
Lock 7, "	....	0.13	7.41	343.19
Lock 8, "	....	0.16	7.57	843.03
Lock 9, "	....	0.33	7.90	342.70
Lock 10, "	....	0.18	8.08	342.52
Lock 11, "	....	0.16	8.24	342.36
Lock 12, "	....	0.15	8.39	342.21
Lock 13, "	....	0.20	8.59	342.01
Lock 14, "	....	0.21	8.80	341.80
Lock 15, "	....	0.27	9.07	341.53
Lock 16, "	....	0.19	9.26	341.34
Lock 17, "	....	0.32	9.58	341.02
Lock 18, "	....	0.19	9.77	340.83
Lower Mohawk acqueduct*	....	2.76	12.53	338.07
Crescent road	34	0.29	12.82	337.78
Dunsbach farm	37	2.36	15.18	335.42
Lock 19, Niskayuna	....	3.45	18.63	331.97
Lock 20, Fowler's	....	2.74	21.37	329.23
Lock 21, upper aqueduct	....	3.22	24.59	326.01
Lock 22, " "	....	0.18	24.77	325.83
Upper Mohawk aqueduct	....	0.08	24.85	325.75
Schenectady, Liberty street	59	4.06	28.91	421.69
Lock 23	....	2.78	31.69	318.91
Lock 24	....	0.78	32.47	318.13
Lock 25, Rotterdam	....	3.80	36.27	314.33
Lock 26, Phillips	....	6.39	42.66	307.94
Lock 27, "	....	0.20	42.86	307.74
Port Jackson, River street	78	2.54	45.40	305.20
Lock 28, Yankee Hill	....	2.67	48.07	302.63
Lock 29, Fort Hunter	....	1.97	50.04	300.56
Fort Hunter	82	0.62	50.86	299.94
Lock 30, Fort Hunter	....	0.01	50.67	299.93

* Distances are given to eastern hollow quoins of locks and ends of aqueducts.

TABLE OF DISTANCES ALONG THE ERIE CANAL — (*Continued*).

NAMES OF PLACES.	No. of bridge.	DISTANCE IN MILES.		
		Place to place.	From Albany.	From Commercial street, Buffalo.
EASTERN DIVISION — (*Continued*).				
Schoharie creek aqueduct	....	0.11	50.78	299.82
Auriesville road	84	1.43	52.21	298.39
Fultonville, Main street	93	3.61	55.82	294.78
Yates farm	101	6.45	62.27	288.33
Lock 31, Sprakers	....	2.25	64.52	286.08
Sprakers, Ferry street	104	0.22	64.74	285.86
Canajoharie	110	3.03	67.77	282.83
Lock 32, Fort Plain	....	3.07	70.84	279.76
Fort Plain, lift-bridge	....	0.28	71.12	279.48
Lock 33, St. Johnsville	....	4.83	75.95	274.65
Lock 34, Mindenville	....	2.57	78.52	272.08
Lock 35, Indian Castle	....	3.18	81.70	268.90
East Canada creek	127	1.18	82.88	267.72
Fink's basin	135	2.45	85.33	265.27
Lock 36, Little Falls	....	0.64	86.07	264.53
Lock 37, " "	....	0.61	86.68	263.91
Lock 38, " "	....	0.17	86.85	263.75
Little Falls, German street	136	0.10	86.95	263.65
Lock 39, Little Falls	....	0.11	87.06	263.54
Lock 40, Jacksonville	....	2.86	89.92	260.68
Lock 41, Fort Herkimer	....	2.54	92.46	258.14
Lower Herkimer road	145	1.37	93.83	256.77
Lock 42, Mohawk	....	1.49	95.32	255.28
Lock 43, "	....	0.26	95.58	255.02
Ilion	151	1.36	96.94	253.66
Lock 44, Ilion	....	1.34	98.28	252.32
Lock 45, Frankfort	....	1.24	99.52	251.08
Frankfort, Madison street	159	0.08	99.60	251.00
Ferguson road	171	5.75	105.35	245.25
Oneida county, east line; boundary between eastern and middle divisions	....	0.89	106.24	244.36
MIDDLE DIVISION.				
Utica, John street	7	2.37	108.61	241.99
Lock 46, Utica	....	0.99	109.60	241.00
Whitesboro road	19	1.28	110.88	239.72
Whitesboro, Clinton street	21	1.48	112.36	238.24
Oriskany, River street	28	3.39	115.75	234.85
Rome, DePuyster street	36	7.61	123.36	227.24
Black River canal junction	36½	0.26	123.62	226.98
New London, Main street	49	7.09	130.71	219.89
Happy Valley road	55	2.76	133.47	217.13
Higginsville, east road	57	1.01	134.48	216.12

TABLE OF DISTANCES ALONG THE ERIE CANAL — (*Continued*).

NAMES OF PLACES.	No. of bridge.	DISTANCE IN MILES.		
		Place to place.	From Albany.	From Commercial street, Buffalo.
MIDDLE DIVISION — (*Continued*).				
Dunbarton	59	1.30	135.78	214.82
Durhamville, Main street	64	3.40	139.18	211.42
Lenox basin	67	2.90	142.08	208.52
Canastota, Main street	69	2.46	144.54	206.06
New Boston	73	3.52	148.06	202.54
Canaseraga	74	1.10	149.16	201.44
Chittenango	75	1.55	150.71	199.89
Bolivar	77	1.20	151.91	198.69
Pool's brook	80	2.18	154.09	196.51
Kirkville	81	1.15	155.24	195.36
Manlius Center	82	3.00	158.24	192.36
Limestone feeder, change	84	0.80	159.04	191.56
Butternut creek aqueduct	....	2.09	161.13	189.47
Thompson's Landing	88	2.21	163.34	187.26
Lock 47, Syracuse	....	2.21	165.55	185.05
Lock 48, "	....	0.19	165.74	184.86
Lock 49, "	....	0.71	166.45	184.15
Weigh lock, Syracuse, Oswego canal junction	....	0.27	166.72	183.88
Geddes street, Syracuse	104	1.16	167.88	182.72
Lock 50, Gere's	....	3.59	171.47	179.13
Belle Isle	111	1.02	172.49	178.11
Nine Mile creek aqueduct	....	1.79	174.28	176.32
Camillus	113	1.12	175.40	175.20
Newport	114	2.11	177.51	173.09
Memphis	115	2.58	180.09	170.51
Peru	116	1.61	181.70	168.90
Jordan, Beaver street	119	3.20	184.90	165.70
Lock 51, Jordan	....	1.47	186.37	164.23
Cold Spring	122	0.33	186.70	163.90
Weedsport, Seneca street	128	3.07	189.77	160.83
Centerport	133	2.21	191.98	158.62
Port Byron, Utica street	134	1.43	193.41	157.19
Lock 52, Port Byron	....	0.76	194.17	156.43
Cayuga and Seneca canal junction	....	3.99	198.16	152.44
Seneca R. aqueduct	....	0.78	198.94	151.66
Wayne county, south line; boundary between middle and western divisions	1	4.32	203.26	147.34
WESTERN DIVISION.				
Wayne county line	1	0.00	203.26	147.34
Pitt lock	2	1.68	204.94	145.66
Clyde, Glasgow street	4	4.77	209.71	140.89

TABLE OF DISTANCES ALONG THE ERIE CANAL — (*Continued*).

NAMES OF PLACES.	No. of bridge.	DISTANCE IN MILES. Place to place.	From Albany.	From Commercial street, Buffalo.
WESTERN DIVISION — (*Continued*).				
Lock 53, Clyde	....	1.26	210.97	139.63
Lock Berlin	9	3.00	213.97	136.63
Lock 54, Lock Berlin	....	0.15	214.12	136.48
Lock 55, Lyons	....	3.35	217.47	133.13
Lock 56, poorhouse	....	1.71	219.18	131.42
Lock 57, Lockville	....	3.16	222.34	128.26
Lock 58, “	....	0.17	222.51	128.09
Lock 59, “	...	0.16	222.67	127.93
Newark, Main street	25	0.63	223.30	127.30
Port Gibson	30	3.40	226.70	123.90
Palmyra, Market street	33	5.15	231.85	118.75
Lock 60, Lower Macedon	....	2.94	234.79	115.81
Lock 61, Upper Macedon	....	0.84	235.63	114.97
Wayneport	42	3.32	238.95	111.65
Knappsville road	43	2.32	241.27	109.33
Fairport, Main street	46	2.29	243.56	107.04
Fullam's basin	47	0.98	244.54	106.06
Bushnell's basin	50	2.98	247.52	103.08
Cartersville	51	1.60	249.12	101.48
Pittsford, Main street	54	1.44	250.56	100.04
Lock 62, Pittsford	....	2.23	252.79	97.81
Lock 63, Brighton	....	2.85	255.64	94.96
Lock 64, Sipples	....	0.54	256.18	94.42
Lock 65, Reservoir	....	0.38	256.56	94.04
Lock 66, Rochester	....	1.05	257.61	92.99
Rochester, Exchange street, swing	....	1.68	259.29	91.31
Four Mile Grocery	89	4.08	263.37	87.23
South Greece	94	3.82	267.19	83.41
Spencerport, Union street	98	3.63	270.82	79.78
Adams' basin	103	2.93	273.75	76.85
Cooley's basin	106	2.44	276.19	74.41
Brockport, Main street	108	2.27	278.46	72.14
Miner's town line	111	2.89	281.35	69.25
Holly	115	1.65	283.00	67.60
Hulberton	119	3.10	286.10	64.50
Brockville	120	1.31	287.41	63.19
Hindsburgh	121	0.77	288.18	62.42
Albion, Batavia street, swing	128	4.48	292.66	57.94
Gaines' basin	130	1.72	294.38	56.22
Eagle Harbor	131	1.54	295.92	54.68
Knowlesville	135	3.06	298.98	51.62
Medina, Church street	139	4.18	303.16	47.44
Shelby basin	142	2.63	305.79	44.81
Middleport, Main street	145	2.58	308.37	42.23

TABLE OF DISTANCES ALONG THE ERIE CANAL — (*Concluded*).

NAMES OF PLACES.	No. of bridge.	DISTANCE IN MILES.		
		Place to place.	From Albany.	From Commercial street, Buffalo.
WESTERN DIVISION — (*Continued*).				
Reynolds basin	149	3.67	312.04	38.56
Gasport	151	1.61	313.65	36.95
Grangeport	152	1.03	314.68	35.92
Millard's	153	1.96	316.64	33.96
Lock 67, Lockport	....	3.46	320.10	30.50
Lock 71, "	....	0.08	320.18	30.42
Heacock's	166	3.09	323.27	27.33
Guard-lock, Sulphur Springs	....	2.09	325.36	25.24
Pendleton	169	1.52	326.88	23.72
Pickard's	174	4.45	331.33	19.27
Bush's	175	3.22	334.55	16.05
Tonawanda side-cut junction	178	4.11	338.66	11.94
Black Rock, change	187	7.34	346.00	4.60
Guard-lock, Black Rock	....	0.47	346.47	4.13
Buffalo, Commercial street	204	4.13	350.60	0.00
Western extremity, Hamburgh canal	.....	1.58	352.18	....

REPORT

OF THE

DIVISION ENGINEER

OF THE

EASTERN DIVISION

FOR THE

YEAR ENDING OCTOBER 1, 1891.

APPENDIX B.

DIVISION ENGINEER'S OFFICE,
EASTERN DIVISION NEW YORK STATE CANALS,
October 1, 1891.

Hon. JOHN BOGART, *State Engineer and Surveyor:*

Sir.— I have the honor to submit the following report on the condition of and engineering operations on the eastern division of the New York State canals for the year ending September 30, 1891:

The eastern division embraces that portion of the Erie canal, with its feeders and side-cuts, extending from the Hudson river, at Albany, to the dividing line between the counties of Herkimer and Oneida, and the whole of the Champlain canal, with its feeders, ponds and side-cuts. For convenience of maintenance and operation it is subdivided into repair sections, as follows:

Section No. 1, Erie, extends from the Hudson river to the head of the lower Mohawk aqueduct, including the Albany basin and the side-cuts at Port Schuyler and West Troy, and also includes that portion of the Champlain canal extending from its junction with the Erie to the northerly end of bridge across the Mohawk river at Cohoes and the dam at Cohoes.

Section No. 2, Erie, extends from the head of the lower Mohawk aqueduct to the head of lock No. 27.

Section No. 3, Erie, extends from the head of lock No. 27 to the head of lock No. 34.

Section No. 4, Erie, extends from the head of lock No. 34 to the westerly end of the division.

Section No. 1, Champlain, extends from the northerly end of Mohawk river bridge, at Cohoes, to the northerly end of bridge across the Hudson river at Northumberland, including sloop-lock and Pond at Troy.

Section No. 2, Champlain, extends from the north end of bridge across the Hudson river at Northumberland to the waste-weir at Dunham's basin.

Section No. 3, Champlain, extends from the waste-weir at Dunham's basin to Lake Champlain.

The mileage of canals, feeders and river improvements is as follows:

NAVIGABLE.

	Miles.
Erie canal, Albany to east line of Oneida county	106.243
Port Schuyler and West Troy side-cuts	.350
Albany basin	.770
Champlain canal, including Waterford side-cuts and Cohoes and Saratoga dams	66.000
Pond above Troy dam	3.000
Glens Falls feeder and pond	12.000
Total	188.363

FEEDERS NOT NAVIGABLE.

	Miles.
Mohawk river, at Rexford Flats	.39
Mohawk river, south side, at Little Falls	.19
Mohawk river at Rocky Rift	3.92
Schoharie creek	.63
Total	5.13

The canals were officially closed for the season of 1890 on the first day of December, and on that day the Champlain canal was cleared of all boats and lockages were suspended. Considerable ice formed on the Erie canal during the two days preceding the date fixed for the closing and as a consequence many boats were delayed in reaching tide-water. Lockages were continued during the first three days in December and strenuous efforts were made to get all boats through the canal. The weather, however, remaining cold, these efforts were abandoned, and as a consequence about forty boats were left in the canal on this division when lockages were finally suspended.

The canals were opened for the season of 1891 on the fifth day of May and navigation has since been steadily maintained with the exception of the interruption incident to two breaks on the Erie canal and three on the Champlain canal, which will be hereafter referred to in detail.

The failure of the last Legislature to enact a law for increasing the lockage capacity of and improving the canals, will, during the next winter suspend the work of improving the canals which has been so vigorously prosecuted for the past six years. The benefits conferred upon the commerce of the State by the policy of lock lengthening entered into in 1884, are so self-evident and so universally admitted by all parties, whose knowledge of the needs of the canal system of the State is sufficient to give their opinion any weight, that any argument by me in favor of pursuing this policy until all of the locks on this division west of lock No. 18 (with the possible exception of locks Nos. 21 and 22, where the lengthening will probably entail the entire rebuilding of at least one set of locks) is unnecessary. This would require the lengthening of locks Nos. 19, 20, 36, 37, 38 and 39, which work could all be easily and economically done in one year, and of which I estimate the cost at $200,000.

The work of improving the Champlain canal so as to obtain a depth of six feet of water with a bottom width of forty-four feet, should, in my opinion, be vigorously prosecuted. I would respectfully renew the recommendation made on this subject in my last annual report. There is no good reason why, if this work is to be done at all, it should not be done expeditiously, and on comprehensive plans covering the whole work. The improving of the remaining forty-one miles of narrow and shallow channel could be economically accomplished within the next two or three years and the benefits of the work already done (and which cannot be reaped by those engaged in through traffic until the whole work is completed) conferred on the navigators of this canal.

WATER SUPPLY.

During the latter half of the month of August and the whole of the month of September, the water in the Mohawk river was very low, and it was with difficulty that navigation could be maintained on the western end of this division. During a great portion of these six weeks it was found impossible to maintain the elevation of water in that portion of the canal lying between Little Falls and the upper Mohawk aqueduct, at the point necessary to insure easy and rapid navigation. Much of this difficulty is due to the defective condition of the dam at Little Falls. During many days of the afore-mentioned period, with an amount of water entirely sufficient for the proper maintenance of navigation passing through this dam by leakage, the water above the dam remained so far below its crest that the Mohawk river, at this point, became converted from a feeder into a drain. The gates which here control the feed from the Mohawk into the canal, being the ordinary "miter-lock gates," are adapted to resist the pressure of water in one direction only, and, therefore, when the water in the pond falls below the level of that in the canal, it passes freely into the river and is lost to that portion of the canal lying between Little Falls and Mindenville.

The serious and increasing difficulty in maintaining navigation on this portion of the Erie canal demands immediate relief, which can be had by the building of a tight stone dam across the Mohawk river here. I earnestly renew the recommendation on this subject, contained in several previous annual reports from this office, and hope that legislative action will be had during the coming winter, authorizing the rebuilding of this dam, estimated cost of which is $15,000. I would also recommend that lift-gates, capable of resisting pressure from two directions, be substituted for the "miter-gates" now in old lock at head of the feeder.

Leakage through the dam across Schoharie creek has also been greatly increasing during the past few years, and has now reached a point that, in time of low water, this creek becomes useless as a feeder. This is a wooden dam, and while I do not think that its condition is such as to require entire renewal, considerable repairs are needed to crest and apron and some filling should be placed in rear of crest.

About one-third of the apron of the dam above the upper Mohawk aqueduct has been carried away and should be replaced.

The 100 feet of apron of the dam across the Hudson river, at

Troy, has been rebuilt, and repairs made to other dilapidated portions thereof at a cost of between $6,000 and $7,000, but in making these repairs the brackets were omitted from the fishway and it, therefore, no longer affords a passageway for fish. The dam is, I think, for the present, reasonably safe, but in the near future either very extensive repairs or the entire rebuilding of the structure will be necessary.

For the past six years a constant deterioration of the condition of the dam across the Mohawk river at Cohoes has been observed, and during the year just closed its weakness has increased so rapidly that I very much fear a break in this structure when the ice passes out of the Mohawk river next spring. This dam was built during the years 1868 to 1871, at a cost of $220,529.88, and is a stone structure 1,616 feet long, varying from twelve to fourteen feet in height, with a timber apron filled with stone placed in front of it. The masonry was built with entire disregard of all well-known laws necessary to secure stability in such a structure. The bonding of the face stone with the backing is very deficient, and in places where the worst failures have occurred the fact is developed that absolutely no connection exists between the two. Bolts connecting the timber apron to the stone-work only reach to the rear of the facestone, so that the slightest settlement of the apron displaces this stone; except for about the northerly 200 feet the coping stones are not properly bolted to the underlying masonry nor clamped together; the timber apron has not a sufficient width of base and its top is fixed at an elevation of eighteen inches below crest of dam, thus securing concussions from ice, logs, etc., which the timber structure is not competent to resist. As a result of these facts the apron (except about 150 feet built in 1885 and 1886 on an improved plan), is now practically destroyed, and in at least four places on the dam the stonework has moved forward from one to two feet, entirely separating the facestone from backing, raising coping from its bed and allowing water to flow freely between the facestone and backing and discharge between the facestone with a force due to the depth of water. Attempts have been made to arrest the failure of this structure by building stone buttresses in front of the worst places and rebuilding portions of the apron, and where such repairs have been made, they have proven entirely effective, but weaknesses of late developed so rapidly, that the cost of needed repairs is now entirely beyond the limits of the ordinary repair fund. I invoke the attention of the Legislature to the urgent necessity of extensive repairs here.

The very dilapidated wall of the sluiceway at the head of the Glens Falls feeder will be rebuilt during the coming winter.

ERIE CANAL.

Prism banks and docking.

Under provisions of chapter 168 of the Laws of 1890, considerable bottoming out was done last spring by the Superintendent of Public Works, the longest continuous stretches of which were the seven miles lying between lock No. 3 and the lower Mohawk aqueduct, through the city of Schenectady, and portions of the three-mile level between locks Nos. 41 and 42. The towing path has been raised and graveled between Crescent and Schenectady and in the city of Cohoes, and sufficient other graveling has been done on the remainder of the division to maintain the towing-path in about the same degree of efficiency as existed at the close of the last fiscal year. Such repairs to banks, docking etc., as were necessary to maintain the safety of the canal have been made. Considerable improvements has been effected through the Cohoes ascent by the placing of new dock sticks on top of the walls and the raising of the towing-path with gravel; but the condition of the walls here are so bad that any improvement thus made is of necessity only temporary in its nature.

Vertical walls built of the shaly blue stone, obtained from quarries near Crescent, which rapidly disintegrate under exposure to the atmosphere, here confine both banks of the canal. The upper portion of most of these walls, and the entire body of much of it, has disintegrated and become useless. It is only a question of a short period of time when it will be absolutely necessary to make large repairs here in order to maintain navigation. I would respectfully refer to my detailed report on this subject of February 12, 1890. I am of the opinion that the sum of $20,000 could be wisely and economically expended here during the coming winter.

The exposed condition of the 6,800 lineal feet of embankment on berme side of the canal, just west of Schenectady, continues to be a great menace not only to the safety of canal navigation but also to valuable private property to which a break in the canal would probably do very serious damage. The embankment here is about seventeen feet high and is built of such material that, as long as it is protected from "wash," it is perfectly safe. The old wooden protection built here some thirty-five years ago did, up to within the past eight years, afford all needed security, but since then a rapid decay has set in and now in numerous detached portions its entire length this bank is exposed to a wash, which is gradually and constantly reducing its top width. It has been only by constant watchfulness, slight and imperfect repairs to the worst portions to the timber work, and refilling, where practicable, the portions washed away that navigation has, up to the present time, been maintained. But the condition has now become so bad that this treatment will not much longer prove efficacious. Some legislative action authorizing the building of either the stone or wooden protection here (and I am of the opinion that it is scarcely necessary to incur the great cost which a stone wall will entail), is much to be desired during the coming winter.

The docking on towing-path side of Canal at Big Nose (to which attention has been called in several preceding annual reports from this office) is now in such bad condition that the rebuilding of at least 400 feet of it during the coming winter is absolutely necessary.

Locks.

Forty-three new lock-gates have been inserted during the past year. The bottom of lock No. 19 has been repaired and large leaks and settling of lock-walls checked, and such repairs have been made to other locks as were necessary to maintain them in a state of efficiency during the year. Chambers of berme locks Nos. 23 and 24 were cut back so that there is now no difficulty in passing through these locks any boats coming to them. The bottom of locks Nos. 13, 20 and 25 should be concreted and replanked during the coming winter.

Aqueducts and culverts.

Two of the arches of Chuctanunda creek culvert in Amsterdam, all of which were filled up with gravel and debris to within three feet of the intrados (thereby reducing capacity of culvert much below its requirements in times of high water), have been thoroughly cleaned out.

The passage of ice out of Bauman's creek last spring carried away the southerly end of the eastern pier of the aqueduct at Canajoharie, and so largely increased the deposit between and over all of the piers that it was impossible to place the aqueduct in position. The destroyed masonry was replaced, and the channel thoroughly cleaned under two of the spans.

The Flat Stone creek aqueduct, which was carried away by the break of July twenty-first, has been rebuilt, and sufficient temporary repairs made to trunks and masonry at the Hoffman and Lasher aqueduct to secure their safety during the present year.

A large amount of the gravel deposit has been removed from channel under the Hoffman aqueduct, but much more work should be done here. The sudden failure of the Flat Stone creek aqueduct (which entailed the cessation of navigation on the Erie canal for a period of twelve days) should forcibly call the attention of the Legislature to the necessity of the requisite legislation to secure the rebuilding of such of these aqueducts as are now unsafe. Attention to this matter has been urged in the two last annual reports from this office, especially recommended by the State Engineer and Surveyor in his annual report for the year ending September 30, 1890, and further urged in a special report to the Legislature in 1891 by the State Engineer and Surveyor and Superintendent of Public Works.

I would again renew my recommendation for the appropriation of $125,000 for rebuilding or repairing aqueducts on the eastern division. Repairs necessary to carry the large aqueduct at the upper and lower Mohawk crossings at Schoharie creek were made last spring; but such temporary expedients cannot safely maintain navigation much longer. The entire system of trusses and braces, supporting the berme side of the above-mentioned three long aqueducts, and those portions of the trunks which are exposed to the ebb and flow of water, are decayed and must be shortly renewed. The greater portion of those parts of the trunks which are covered with water during the season of navigation are still sound, though some spans in each aqueduct need entire renewal.

The trunks of aqueducts at Hoffmans, Yatesville, Lashers, Canajoharie and Ilion need immediate renewal; and repairs more or less extensive are needed to the masonry of the two Mohawk aqueducts and those at Schoharie, Takkon and Ferguson creeks and at Yatesville, Canajoharie, Fort Plain and Ilion. The very extensive masonry of the two Mohawk aqueducts has been greatly damaged and is being constantly exposed to still greater injury by reason of the absence of the timber protection against ice on the up-stream side. This protection should be replaced on ice-breakers at once.

Extensive repairs are needed to the culvert through which the Rocky Rift feeder is carried under Castle creek.

Waste-weirs.

No special change in the condition of waste-weirs has occurred during the past year. The renewal of the bulkhead of the weir in West Troy basin and the repair of archway forming exit therefrom, will be absolutely necessary during the coming winter, and as this work can be more economically done during the period of low water in river (thus avoiding an expensive coffer dam) it should be prosecuted as soon after the close of navigation as the condition of the river will permit. Waste-weir No. 1 needs a new bulkhead. Waste-weir No. 15 is entirely decayed and must shortly be rebuilt. It is located just at the head of lock No. 36, and when water is being drawn from gates, or discharged from spillway, the current formed renders it difficult for boats to enter the lock. When it is rebuilt, it should be moved westward as far as the contour of adjacent hills will allow.

Bridges and abutments.

The following bridges have been built during the past year: Nos. 60, 61, 62, 76, 93, 101, 113, 118, 132, 141, 147 over the Erie canal; Nos. 2, 3, 10, 11 over Rocky Rift feeder, and No. 2 over Schoharie creek feeder; total, sixteen.

Berme abutment of bridge No. 43 has been dug behind and thrown back. The following wooden bridges should be rebuilt during the coming winter: Nos. 5, 8, 30, 31, 32, 34, 36, 37, 46, 52, 55, 71, 72, 83, 87, 96, 97, 100, 114, 120, 128, 129, 132, 135, 163, 166, 167, 171, 172. The cast-iron arch bridge at Amsterdam, No. 79, should be replaced by a stronger structure. Repairs more or less extensive, but not amounting to rebuilding, are needed to bridge Nos. 9, 10, 18, 19, 25, 26, 27, 29, 33, 56, 70, 80, 84, 90, 102, 109, 112, 124, 125, 136, 138, 148, 150.

New berme abutments are needed at bridges Nos. 39 and 74. Berme abutments of bridges Nos. 42, 112, and 131 should be dug behind and settled back and various repairs to wings, etc., are needed to abutments of bridges Nos. 17, 40, 41, 119, 130, 149, 164 and 169. The Electrical Development Company, of Schenectady, having made an application for a permit to run their electric cars across the bridges at State street and at Rotterdam street, in the city of Schenectady, and the iron bridge at State street being considered unsafe for such traffic, this company has built here three new iron trusses for carrying the roadway (the old sidewalk trusses being retained and renewed the floor system so that this bridge which has heretofore, in several reports from this office, been pronounced unsafe for passage of the traffic to which it is ordinarily exposed, has now been rendered perfectly safe without cost to the State. The wooden bridge at Rotterdam street was badly decayed and entirely inadequate to ordinary use and a contract was entered into with the Electrical Development Company to build a new bridge here for the sum of $400, same being the estimated cost of renewal of old wooden structure. Under this contract this company has erected a substantial iron structure at a cost to them (including repairs to masonry) of not less than $3,000.

EXTRAORDINARY REPAIRS.

Lengthening locks, Chapter 168, *Laws of* 1890.

Berme locks Nos. 40, 41, 42 and 43 were lengthened at the foot during the past winter as follows:

Lock No. 4, Hughes Bros., contractors.—The material underlying this lock is a coarse compact gravel, sufficiently stable in its nature to render the use of bearing piles unnecessary. Concrete varying in depth, between six and twenty-four inches, was placed between bottom of foundation timbers and the gravel. The facestone was obtained from Split Rock in Onondaga county; backing from Canajoharie. Fender piles were driven here.

Lock No. 41, Hughes Bros., contractors.— Founded on piles driven to an average depth of six and one-half feet below bottom of timber. Facestone came from quarries at Sugar river and Split Rock; backing from Canajoharie.

Lock No. 42, Casey, Murray & Co., contractors.— Founded on piles driven to average depth of ten and one-half feet below bottom of timber. Facestone came from quarries at Chaumont and backing from near Newport and Canajoharie.

In connection with this contract two new bridge abutments were built for bridge No. 147; both abutments being set back so as to obtain standard section of canal and eighteen feet width of towpath, and new approaches were built thereto. A new wrought-iron superstructure was placed on these abutments by the Groton Bridge Manufacturing Company.

Lock No. 43, Casey, Murray & Co., contractors.— Founded on piles driven to an average depth of thirteen and one-half feet below bottom of timber. Stone was obtained from same source as that used at lock No. 42.

Machinery, of the same design as that used last year, for drawing boats into locks, was erected at the above-mentioned four locks by Nicholas and William H. Wemple, contractors.

DREDGING ALBANY BASIN.

Chapter 168, *Laws of* 1890.

Under a contract with P. W. Myers, during the fall of 1890, a depth of seven feet of water was obtained over the entire area of basin, except that portion obstructed by the State street and Columbia street bridges and the steamboat landings. Since the work was done, however, a large amount of deposit has again accumulated in this basin, and I am still of the opinion that the maintenance of a proper depth of water here, can only be effected by deflecting the sewerage of the city of Albany so that it may be discharged at some point south of this basin.

BRIDGE AT MAIN STREET, FULTONVILLE.

Chapters 149, *Laws of* 1889, *and* 333, *Laws of* 1890.

These two laws appropriated the sum of $10,000 for the purpose of changing, altering or widening the bridge at this point. Under it a new towing-path abutment (giving eighteen feet width of towing-path) has been built, and necessary changes in berme abutment made; approaches graded and sidewalk flagging and railing placed in position by Isaac Thomas, contractor. A new wrought-iron superstructure has been built by the Rochester Bridge Company.

LIFT-BRIDGE AT CHURCH STREET, SCHENECTADY.

Chapter 77, *Laws of* 1891.

A new lift-bridge was built here this spring. Work on the substructure was done by Flagler & Devlin, contractors, and on the superstructure by the Hilton Bridge Construction Company, contractors. In order to obviate the difficulty encountered on lift-bridges heretofore built of the slipping of cables passing over single sheaves, two cables winding on a spiral drum are used, one being attached to bridge floor and one to counter weight boxes. Continuous wrought-iron counter weight boxes have been substituted for the detached cast-iron boxes heretofore used, so that failure of any single cable will not result in a serious accident. Pneumatic lift-gates, which are raised and lowered independently of the motion of the bridge floor, have been erected.

REPAIRS TO MOYER CREEK.

Chapters 309, *Laws of* 1889, 266, *Laws of* 1890, 113, *Laws of* 1891.

The contract awarded to Thomas and Nelson, of which mention was made in my last report, has been completed and a final account therefor rendered. This work was paid for out of the ordinary repair fund and was only designed to temporarily protect the dam nearest the aqueduct and thus preserve canal navigation, and also to prevent the destruction of the bridge abutments on Main street, Frankfort, pending legislative action authorizing further necessary repairs. The first of these objects was satisfactorily accomplished, but the work was not sufficiently extended to protect the abutments, and during the spring freshets these abutments were so badly damaged as to necessitate the erection of a temporary bridge supported by timber bents. The Legislature, having by chapter 113, Laws of 1891, appropriated the sum of $20,000 for restoring and protecting this channel, plans have been prepared for doing this work and a contract for the same has been awarded to Brummelkamp & Conron. The work is now being vigorously prosecuted by the contractors.

The sum appropriated is, however, not sufficient to properly complete the work, and plans under which present contract is being executed have been so designed that cost of work will be kept within the limits of the funds appropriated. It is, however, very essential to the security of the work now in progress that one more overfall be built and walls of creek be extended from north end of present work to a junction with a culvert under the New York Central and Hudson River railroad, and also that a new vertical wall be built on the easterly side of creek from a point 100 feet north of the aqueduct to the first dam. I estimate cost of this work at $5,000 and earnestly advise an appropriation of this amount for this purpose.

LIFT-BRIDGES AT WEST TROY.

Chapter 231, *Laws of* 1891.

Plans have been prepared for a lift-bridge at this point similar in general design to those adopted for the bridge at Church street, Schenectady, except that the motive power is obtained from the village water mains instead of the turbine used at the latter point, at an estimated cost of $13,489.25; the work has been advertised for a letting to be held on the sixth day of October.

CHAMPLAIN CANAL.

Prism, banks, etc.

The work of raising the towing path on section No. 2 was prosecuted during the fall of 1890, and much improvement resulted therefrom; total cost, $4,940, which was defrayed from funds appropriated by chapter 168, Laws of 1890, and the remainder of this canal, while no marked improvement has been made to the condition of the towing path, no deterioration has been allowed to occur.

On the opening of navigation in May, serious leaks developed through the gravel formation in bottom of canal along the new work done and through the village of Mechanicville and it was found necessary to build a drain to carry off this leakage from that portion of this work lying between bridge No. 21 to a point 300 feet north of same. This was done at a cost of $1,082.

Serious settlement of the high embankment adjacent to the Hudson river, south of bridge No. 88, occurred during the past summer; it was checked by the laying of tile to concentrate the flow of the water leaking under and through the 1,500 feet of vertical wall at this point. This is a dangerous bank and I would advise the placing of sheet piling and puddle at toe of this wall during cessation of navigation this year, a further examination of and where necessary repointing this wall.

A very leaky and dangerous towpath exists just south of "Bullard's Bend" improvement, for a distance of 400 feet adjacent to the two breaks which have occurred here this year. A puddle wall three feet thick, extending to a point one foot below canal bottom, should be built in center of towing path here.

Locks.

Thirty new lock-gates have been inserted. Repairs to wickets at locks Nos. 5 and 6 have overcome the difficulties of feeding, of which I spoke of in my last report. I would renew my recommendation of last year, that walls of locks Nos. 6 and 9 be cut back and thoroughly grouted.

The grouting of lock No. 16 has been successful and no difficulty has been experienced here during the year.

Aqueducts.

The trunks of aqueducts at Moses Kill and Fort Edward were rebuilt last spring. About 100 feet of vertical wall laid in cement should be built south of the Fort Edward aqueduct on the berme side, and repairs are needed to masonry at Fort Miller aqueduct.

Waste-weirs, spillways, and culverts.

Temporary repairs have been made to waste-weirs at Mechanicville and Stillwater, but it will soon become necessary to rebuild both of these structures.

During last spring the masonry of Wilbur's basin waste-weir was repointed and a portion of the leak at this point shut off. There still remains a considerable leak here, and effort should be made by sheet piling or otherwise to cut this off during the coming winter.

Bridges and abutments.

The following bridges have been built during the past year: Nos. 9, 16, 17, 42, 43a, 49, 59, 66, 114, 118, 130, on the Champlain canal, and three bridges in Waterford over discharge from lock. Total 14. The following bridges should be rebuilt during the coming winter: Nos. 3, 6, 11, 19, 21, 23, 32, 33, 38, 54, 55, 67, 70, 73, 100, 107, 111, 115, 132 and 133. Total 20.

Floor system of bridge over Glens Falls feeder, at Glen street, Glens Falls, has been entirely renewed and strengthened. The iron trusses of this bridge are, however, not strong enough to safely carry the loads to which they are exposed.

Bridges over the old feeder at Fort Edward and over the Glens Falls feeder, at Whitehall street, Sandy Hill, have been strengthened, under plans approved by this department, by the Electric Railroad Company, to render them safe for the passage of electric cars.

The north abutment of Change bridge, near head of Glens Falls feeder, has been rebuilt.

With this exception no work had been done on bridge abutments during the year, and I would respectfully renew the recommendation on this subject contained in my last report.

EXTRAORDINARY REPAIRS.

Chapter 168, *Laws of* 1890.

In my last annual report will be found detailed descriptions of six proposed improvements under this law. Contracts for this work were awarded and work done as follows:

Contracts No. 1, Cunningham & Riley, contractors.— The culvert was rebuilt here and founded on rock under towing-path embankment, across prism of canal, and to a point six feet west of berme inner angle. West of this latter point the rock dipped rapidly and walls were founded on concrete and timber. The vertical wall on both berme and towing-path sides, adjacent to culvert, were rebuilt and founded on rock.

Contract No. 2, Cunningham & Riley, contractors.— This work was completed substantially according to plan. At the southerly end of the work it was found necessary to build a concrete protection in front of the vertical wall extending through the porous gravel found here down to the underlying rock, varying from two to eight feet in depth; and, adjoining the lift-bridge, a vertical wall in cement, 100 feet long, was substituted for the timber docking shown on plans. The removal of silt, incident to the necessary deepening of the canal here, and the consequent exposure to the direct impact of water of the porous gravel which forms the bottom of the canal for the greater part of the length of this contract, resulted in serious leakage through the village of Mechanicville when the water was let into the canal. The cellars of many of the houses in the village, some of them located one-quarter mile south of the southerly limits of this improvement, were flooded. The deposit of silt, however, relieved very much of this trouble within a month after the opening of the canal, and the building of the box drain, heretofore referred to, was entirely effective along that portion of the improvement on which it was placed. There are now only two points at which any extensive leaks exist, and those, while injurious to private property, do not injure any canal structure. An attempt will be made during the coming winter to stop these two leaks.

Contracts 3, 4 and 6, John W. Whalen, contractor.— These contracts were all completed in accordance with plans and specifications, and boats now easily pass along the limits of this improvement where, heretofore, wedges were of daily occurrence.

Contract No. 5 was awarded to Dardis & Gordon (the lowest bidders), but they failed to enter into contract and no work was done here during the past winter. The work was readvertised, and, on August 21, 1891, a contract was executed with the Troy Public Works Improvement Company, contractors. A considerable portion of this work can be done during the season of navigation. The contractors are now prosecuting it.

WALL AT WHITEHALL.

Chapter 55, *Laws of* 1889, *and* 266, *Laws of* 1890.

Under a contract entered into February 16, 1891, with Jeremiah Adams, contractor, has rebuilt 200 feet of vertical wall and raised and coped 350 additional feet northward from a point 350 feet south of lock No. 21.

SLUICEWAY AT HEAD OF GLENS FALLS FEEDER.

Chapter 271, *Laws of* 1891.

Plans for the rebuilding of this wall, at an estimated cost of $5,324, have been prepared, and the work has been advertised for a letting, to be held on the twenty-sixth day of October.

BREACHES.

There have been five breaks on this division during the year just closed, three on the Champlain canal and two on the Erie canal, as follows:

First. October 28, 1890, about twenty feet of towing-path embankment 300 feet north of Satterly's waste-weir on the Champlain canal, was washed out, but the cutting only extended a few feet below water surface. Repairs were promptly made and navigation resumed after a delay of one and one-half days.

Second. Break at Bullard's Bend, about one-half mile north of Schuylerville on the Champlain canal. The towing-path embankment here is in a weak and leaky condition, and on the evening of May second, one of these leaks had increased so much as to carry away about twenty feet of the embankment to a depth of about three feet below canal bottom. The slope wall remained standing. Repairs were made by placing a row of sheet piling, protected by a puddle wall across the breach, and feeding was resumed at 5 p. m., May third, and level rapidly refilled so that no delay occurred in the opening of canal on May fifth as advertised.

Third break occurred June tenth at 3.30 p. m. About forty feet of the berme embankment, immediately east of the easterly abutment of the Yatesville aqueduct on the Erie canal (about one-half mile west of Downings) was washed out to a depth of over five or six feet below canal bottom entirely exposing the masonry of the abutment but not injuring the same. Repairs were made by the building of a timber crib, filled with puddle across the break; replacing with puddle the material washed out in prism below canal bottom; and filling with earth and stone, back of the crib. Feeding was resumed June thirteenth, and navigation was reopened at 2 a. m., June sixteenth. Total cessation of navigation, five and one-half days.

Fourth break occurred on the twenty-second day of July at 5.30 p. m. The three-span aqueduct, over Flat Stone creek on the Erie canal (one and one-half miles west of lock 24) failed. The entire wooden trunk (except the vertical side on berme) was carried away, and the two stone piers and the masonry arches were demolished and bed of creek washed out to a depth of twelve feet below the ordinary surface of water in creek. The masonry abutments at east and west ends of aqueduct were not injured but the washing out of creek bed approached to within about one foot of their base and had the rush of water continued half hour longer they would have failed. Repairs were effected by filling in the washed out creek bed with stone, thoroughly grouted, building on this stone foundation two timber cribs filled with stone as supports for the timber trunk and towing-path bridge, rebuilding the timber trunk and building a new bridge. The temporary structure thus built has proven entirely efficient and little or no settlement was detected (after careful observations) when the load of water was placed on it. The structure is now safe for five or six years or until the timber cribs begin to decay, but new stone piers and arches will eventually be needed here. Feeding was resumed, August first, at 7 a. m. Navigation reopened August second at 2 a. m. Total suspension of navigation, ten and one-half days.

Fifth break occurred on August thirteenth near Bullard's Bend, on the Champlain canal, at a point about 300 feet north of the break of May second. It was similarly repaired and entailed a suspension of navigation of thirty hours.

SHINNECOCK AND PECONIC CANAL.

Chapter 436, *Laws of* 1890.

Under a contract with P. J. Brummelkamp, work on this channel for securing a flow of salt water into the Shinnecock bay has been steadily in progress during the fall of 1890 and the summer of 1891. The jetties at the junction with Peconic bay have been completed and 4,200 cubic yards of material removed by dredge. Three thousand three hundred feet of the channel is now completed with a width of forty feet on bottom and four and one-half feet depth of water at low tide, and 1,100 feet of channel yet remains to be dredged. Revised plans for bridge and stop-gate have been prepared, but as yet no contract has been let for this latter work.

IMPROVEMENT OF SARANAC RIVER.

Chapter 359, *Laws of* 1890.

The work of building a wooden lock here upon the modified plan, mentioned in my last report, has been substantially completed, but as a small amount of excavation yet remains to be done, no final account has yet been rendered therefor.
eight days.

ENGINEERING ORGANIZATION.

I have been assisted in the conduct of the work devolving on this department during the past year, by Mr. J. P. Kelly, resident engineer; Mr. E. B. Noyes, assistant engineer in charge of improvement on the Champlain canal; and Messrs. Martin Schenck, George I. Bailey and T. C. Leutze, assistant engineers in charge of the lock lengthening and other contract work heretofore detailed, with a corps of subordinate employes as will appear in the appended tables. Assistant Engineer Leutze and party have been detailed, during a considerable portion of the year, to work under the direction of the Attorney-General; and Assistant Engineer Schenck to work under the direction of the Commissioner of the New Capitol.

I append hereto tables giving names, compensation and rank of engineers employed on this division during the last fiscal year. Also tables showing contracts completed and final accounts rendered during the same period as well as a table showing contracts pending on the 30th day of September, 1891. As a good many changes have occurred since 1888, in the character of structures on this division, I have thought it wise to prepare new tables of locks, waste-weirs, culverts and bridges on the Erie canal and of bridges on the Champlain canal, which are herewith transmitted.

I have the honor to be,

Respectfully yours.

CHAPMAN L. JOHNSON,

Division Engineer.

ORDINARY REPAIRS — ERIE CANAL.

Chapter 266, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total	mount.
Chapman L. Johnson	Division engineer	....	$2,400 00 per annum	$1,599 96	$469 56	$2,069 52	
John P. Kelly	Resident engineer	....	2,000 00 per annum	820 49	101 92	922 41	
A. S. Kibbe	Assistant engineer in charge	124	6 00 per day	744 00	110 45	854 45	
T. C. Leutze	Assistant engineer in charge	24	5 00 per day	120 00	24 23	144 23	
Martin Schenck	Assistant engineer in charge	3	6 00 per day	18 00	1 00	19 00	
J. E. Ostrander	Leveler	1	4 50 per day	4 50	50	5 00	
F. W. Battershall	Leveler	2	4 50 per day	9 00	....	9 00	
F. W. Battershall	Rodman	153	3 50 per day	535 50	50 94	586 44	
J. L. Clancy	Rodman	104	3 50 per day	364 00	....	364 00	
J. H. Jones	Rodman	12	3 50 per day	42 00	85	42 85	
C. M. Pepson	Rodman	1	3 50 per day	3 50	75	4 25	
Jas. Ryan, Jr.	Rodman	34	3 50 per day	119 00	5 22	124 22	
B. Frederick	Chainman	145	2 50 per day	362 50	29 58	392 08	
John J. Allen	Chainman	84	4 00 per day	336 00	....	336 00	
G. B. Hughes	Chainman	2	2 50 per day	5 00	3 84	8 84	
J. W. Murphy	Chainman	27	2 50 per day	67 50	....	67 50	
Wm. Miller	Chainman	25	2 50 per day	62 50	16 55	79 05	
Wm. E. Lutjens	Chainman	10	2 50 per day	25 00	13 46	38 46	
							$6,067 80

Incidental expenses.

Livery	$92 50	
Postage and telegraph	151 16	
Labor	107 30	
Stationery	250 64	
Miscellaneous	148 75	
		750 85
		$6,817 65

Chapter 570, *Laws of* 1889.

T. C. Leutze	Assistant engineer in charge	25	$6 00 per day	$150 00	$58 99	$208 99	
Geo. I. Bailey	Assistant engineer in charge	12	6 00 per day	72 00	27 65	99 65	
C. M. Pepson	Rodman	6	3 50 per day	21 00	11 71	32 71	
John Hickey	Rodman	14	3 50 per day	49 00	23 94	72 94	
E. J. Waldron	Chainman	8	2 50 per day	20 00	15 93	35 93	
						$450 22	
Incidental expenses.							
Postage and telegraph					$1 80		
Miscellaneous					19 10		
						20 90	
							471 12
							$7,288 77

ORDINARY REPAIRS — CHAMPLAIN CANAL.

Chapter 266, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.	Amount.
Chapman L. Johnson	Division engineer	....	$2,400 00 per annum	$800 04	$142 62	$942 66	
John P. Kelly	Resident engineer	....	2,000 00 per annum	71 19	10 61	81 80	
E. B. Noyes	Assistant engineer in charge	22	6 00 per day	132 00	34 00	166 00	
A. T. Kibbe	Assistant engineer in charge	4½	6 00 per day	27 00	5 50	32 50	
H. M. Rood	Assistant engineer	9	5 00 per day	45 00	1 50	46 50	
G. D. Baltimore	Leveler	27	4 50 per day	121 50	....	121 50	
F. W. Battershall	Rodman	74	3 50 per day	259 00	15 26	274 26	
Edwin Styring	Rodman	24	3 50 per day	84 00	11 16	95 16	
T. A. Paterson	Rodman	38	3 50 per day	133 00	12 89	145 89	
J. C. Daugrey	Rodman	11	3 50 per day	38 50	2 00	40 50	
John J. Allen	Chainman	249	4 00 per day	996 00	1 43	997 43	
Wm Miller	Chainman	44	2 50 per day	110 00	4 46	114 46	
B. Frederick	Chainman	102	2 50 per day	255 00	23 12	278 12	
J. W. Murphy	Chainman	8½	2 50 per day	21 25	3 36	24 61	
Wm. E. Lutjens	Chainman	3	2 50 per day	7 50	7 51	15 01	
							$3,376 40
Incidental expenses.							
Livery						$15 00	
Postage and telegraph						46 94	
Labor						58 00	
Stationery						79 49	
Miscellaneous						98 46	
							297 89
							$3,674 29

Chapter 570, *Laws of* 1889.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
T. C. Leutze	Assistant engineer in charge	28	$6 00 per day	$168 00	$28 81	$196 81
Geo. I. Bailey	Assistant engineer in charge	19	6 00 per day	114 00	....	114 65
A. T. Kibbe	Assistant engineer in charge	27	6 00 per day	162 00	....	162 00
J. M. Farley	Leveler	16	4 50 per day	72 00	23 67	95 67
C. M. Pepson	Rodman	4	3 50 per day	14 00	11 80	25 80
T. A. Paterson	Rodman	16	3 50 per day	56 00	13 13	69 13
Edwin Styring	Rodman	6	3 50 per day	21 00	6 25	27 25
John Hickey	Rodman	1	3 50 per day	3 50	....	3 50
C. H. Barber	Rodman	4	3 50 per day	14 00	10 10	24 10

B. Frederick	Chainman	7	2 50 per day	17 50	14 21	31 71	
E. J. Waldron	Chainman	6	2 50 per day	15 00	17 98	32 98	
Wm. E. Lutjens	Chainman	16	2 50 per day	40 00	16 11	46 11	
						$839 01	
Incidental expenses.							
Postage and telegraph					$1 25		
Livery					69 00		
Miscellaneous					5 89		
						76 14	
							915 15
							$4,589 44

EXTRAORDINARY REPAIRS — ERIE CANAL. (LENGTHENING LOCKS.)

Chapter 168, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel	Total.	Amount.
John P. Kelly	Resident engineer	....	$2,000 00 per annum.	$542 79	$71 38	$6 4 17	
Geo. I. Bailey	Assistant engineer in charge	....	6 00 per day	1,516 50	89 88	1,606 38	
Martin Schenck	Assistant engineer in charge	193½	6 00 per day	1,161 00	63 94	1,224 94	
J. E. Ostrander	Leveler	264½	4 50 per day	1,190 00	9 62	1,199 87	
R. C. Strachan	Leveler	111	4 50 per day	499 50	17 90	517 40	
G. D. Baltimore	Leveler	52	4 50 per day	234 00	4 09	238 09	
L. T. Carver	Rodman	130½	3 50 per day	456 75	2 75	459 50	
J. H. Jones	Rodman	217	3 50 per day	759 50	6 96	766 46	
James Ryan, Jr	Rodman	166	3 50 per day	581 00	14 57	595 57	
C. H. Barber	Rodman	248¾	3 50 per day	870 63	7 49	878 12	
C. M. Pepson	Rodman	191	3 50 per day	668 50	5 77	674 27	
F. W. Battershall	Rodman	3	3 50 per day	10 50	1 09	11 59	
Jas. T. Gaffney	Chainman	197½	2 50 per day	493 75	4 94	498 69	
Wm. Miller	Chainman	152	2 50 per day	380 00	24 71	404 71	
Geo. B. Hughes	Chainman	20	2 50 per day	50 00	....	50 00	
							$9,739 76
Incidental expenses.							
Livery						$516 50	
Postage and telegraph						56 79	
Labor						7 00	
Stationery						232 85	
Fuel and light						87 02	
Office rent						288 08	
Miscellaneous						278 87	
							1,416 56
							$11,156 32

BOTTOMING OUT ERIE CANAL.

Chapter 168, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.	Amount.
Geo. I. Bailey	Assistant engineer in charge	15	$6 00 per day	$90 00	$61 77	$151 77	
F. W. Battershall	Rodman	10	3 50 per day	35 00	9 55	44 55	
C. M. Pepson	Rodman	3	3 50 per day	10 50	3 09	13 59	
G. B. Hughes	Chainman	5	2 50 per day	12 50	5 43	17 93	
J. W. Murphy	Chainman	3	2 50 per day	7 50	3 18	10 68	
Wm. Miller	Chainman	2	2 50 per day	5 00	8 96	13 96	
B Frederick	....	21	2 50 per day	52 50	20 17	72 67	
							$325 15
Incidental expenses.							
Livery						$60 00	
Postage and telegraph						65	
Labor						2 50	
Miscellaneous						55	
							63 70
							$388 85

DREDGING ALBANY BASIN.

Chapter 168, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.	Amount.
Martin Schenck	Assistant engineer in charge	8	$6 00 per day	$48 00	....	$48 00	
C. M. Pepson	Rodman	36	3 50 per day	126 00	....	126 00	
							$174 00
Incidental expenses.							
Stationery						$4 50	
Miscellaneous						34 40	
							38 90
							$212 90

EXTRAORDINARY REPAIRS — CHAMPLAIN CANAL.

Chapter 168, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.	Amount.
John P. Kelly	Resident engineer	....	$2,000 00 per annum	$264 30	$78 87	$343 17	
A. T. Kibbe	Assistant engineer in charge	15	6 00 per day	90 00	10 40	100 40	
Ellis B. Noyes	Assistant engineer in charge	287	6 00 per day	1,722 00	216 01	1,938 01	
H. M. Rood	Assistant engineer in charge	265	5 00 per day	1,825 00	5 02	1,830 02	
J M. Farley	Assistant engineer in charge	3	5 00 per day	15 00	4 34	19 34	
J. M. Farley	Leveler	36	4 50 per day	162 00	11 89	173 89	
William J. Smith	Rodman	234	3 50 per day	819 00	7 20	826 20	
J. C. Dougrey	Rodman	303	3 50 per day	1,060 50	10 10	1,070 60	
Edwin Styring	Rodman	228	3 50 per day	798 00	147 83	945 83	
T. A. Paterson	Rodman	259	3 50 per day	906 50	100 83	1,007 33	
William E. Lutjens	Chainman	171	2 50 per day	427 50	122 19	549 69	
C. H. Mory	Chainman	234	2 50 per day	585 00	26 10	611 10	
J. W. Murphy	Chainman	11	2 50 per day	27 50	1 20	28 70	
G. B. Hughes	Chainman	79	2 50 per day	197 50	2 40	199 90	
							$9,144 18
	Incidental expenses.						
Livery						$344 50	
Postage and telegraph						87 29	
Stationery						130 54	
Fuel and light						22 03	
Office rent						91 50	
Miscellaneous						201 06	
							826 92
							$9,971 10

MAIN STREET BRIDGE, FULTONVILLE.

Chapter 333, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.	Amount.
John P. Kelly	Resident engineer	....	$2,000 00 per annum	$92 79	$42 26	$135 05	
F. W. Battershall	Rodman	....	3 50 per day	14 00	9 84	23 84	
C. H. Barber	Rodman	....	3 50 per day	3 50	2 40	5 90	
Wm. Miller	Chainman	....	2 50 per day	2 50	2 46	4 96	
B. Frederick	Chainman	....	2 50 per day	15 00	17 22	32 22	
							$201 97
Incidental expenses.							
Postage and telegraph						$1 16	
Miscellaneous						2 01	
							3 17
							$205 14

CHURCH STREET BRIDGE, SCHENECTADY.

Chapter 77, Laws of 1891.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.	Amount.
John P. Kelly	Resident engineer	....	$2,000 00 per annum	$115 29	$19 78	$135 07	
T. C. Leutze	Assistant engineer in charge	42	6 00 per day	252 00	58 95	310 95	
F. W. Battershall	Rodman	11	3 50 per day	38 50	7 58	46 08	
C. M. Pepson	Rodman	8	3 50 per day	28 00	10 44	38 44	
Jas. Ryan, Jr.	Rodman	1	3 50 per day	3 50	1 18	4 68	
B. Frederick	Chainman	21	2 50 per day	52 50	26 68	79 18	
Wm. Miller	Chainman	2	2 50 per day	5 00	2 86	7 86	
Geo. B. Hughes	Chainman	9	2 50 per day	22 50	9 68	32 18	
							$653 94
Incidental expenses.							
Postage and telegraph						$3 86	
Plans						215 74	
Miscellaneous						2 00	
							221 60
							$875 54

REPAIRING MOYER CREEK.

Chapter 113, *Laws of* 1891.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.	Amount.
Geo. I. Bailey	Assistant engineer in charge	20	$6 00 per day	$120 00	$14 48	$134 48	
C. H. Barber	Rodman	33	3 50 per day	115 50	....	115 50	
J. H. Jones	Rodman	6	3 50 per day	21 00	14 72	35 72	
Edwin Styring	Rodman	28	3 50 per day	98 00	1 82	99 82	
							$385 52
Incidental expenses.							
Postage and telegraph						$3 19	
Plans						33 95	
Office rent						10 00	
Miscellaneous						4 78	
							51 92
							$437 44

LIFT-BRIDGE, NINETEENTH STREET, WEST TROY.

Chapter 239, *Laws of* 1891.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.	Amount.
John P. Kelly	Resident engineer	....	$2,000 00 per annum	$16 29	$0 60	$16 89	
T. C. Leutze	Assistant engineer in charge	13	6 00 per day	78 00	4 40	82 4	
James Ryan, Jr	Rodman	4	3 50 per day	14 00	2 80	16 80	
Wm. E. Lutjens	Chainman	6	2 50 per day	15 00	4 77	19 77	
Wm. Miller	Chainman	5	2 50 per day	12 50	3 50	16 00	
							$151 86
Incidental expenses.							
Plans for bridge							246 10
							$397 96

EXAMINATIONS AND MAPS.

Chapter 295, *Laws of* 1890. *Chapter* 302, *Laws of* 1891.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary	Travel.	Total.	Amount.
Geo G. Bailey	Assistant engineer in charge	15	$6 00 per day	$90 00	....	$90 00	
A T. Kibbe	Assistant engineer in charge	31	6 00 per day	186 00	$255 29	441 29	
F. W. Battershall	Leveler	26	4 50 per day	117 00	....	117 00	
J. L. Clancy	Rodman	27	3 50 per day	94 50	....	94 50	
Wm. Miller	Chainman	31	2 50 per day	77 50	67 48	144 98	
							$887 77
	Incidental expenses.						
Livery						$3 32	
Postage and telegraph						18 00	
Stationery						10 00	
Miscellaneous						10 95	
							42 27
							$930 04

STATE BOARD OF CLAIMS.

Chapter 295, *Laws of* 1890. *Chapter* 302, *Laws of* 1891.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.	Amount.
T. C. Leutze	Assistant engineer in charge	193	$6 00 per day	$1,158 00	$308 80	$1,466 80	
G. I. Bailey	Assistant engineer in charge	8	6 00 per day	48 00	34 85	82 85	
F. W. Battershall	Rodman	5	3 50 per day	17 50	7 40	24 90	
James Ryan, Jr.	Rodman	72	3 50 per day	252 00	148 07	400 07	
J. H. Jones	Rodman	26	3 50 per day	91 00	44 94	135 94	
B. Frederick	Chainman	14	2 50 per day	35 00	32 30	67 30	
G. B. Hughes	Chainman	5	2 50 per day	12 50	11 31	23 81	
J. W. Murphy	Chainman	4	2 50 per day	10 00	10 80	20 80	
William Miller	Chainman	70	2 50 per day	175 00	148 08	323 08	
William E. Lutjens	Chainman	108	2 50 per day	275 00	217 93	492 93	
							$3,038 48
Incidental expenses.							
Livery						$178 50	
Postage and telegraph						10 92	
Labor						14 00	
Stationery						2 75	
Miscellaneous						107 90	
							314 07
							$3,352 55

SURVEY SARANAC RIVER.

Chapter 359, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.	Amount.
Ellis B. Noyes	Assistant engineer in charge	5	$6 00 per day	$30 00	$8 78	$38 78	
Edwin Styring	Rodman	29	3 50 per day	101 50	10 51	112 01	
John Hickey	Rodman	35	3 50 per day	122 50	9 00	131 50	
							$282 29
Incidental expenses.							
Postage and telegraph						$0 25	
Miscellaneous						2 00	
							2 25
							$284 54

SHINNECOCK AND PECONIC CANAL.

Chapter 436, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.	Amount.
John P Kelly	Resident engineer		$2,000 00 per annum	$76 86	$60 28	$137 14	
A. P. Folwell	Leveler	12	4 50 per day	54 00	8 90	62 90	
D. R Lee	Leveler	304	4 50 per day	1,368 00	91 68	1,459 68	
							$1,659 72
Incidental expenses.							
Postage and telegraph						$10 18	
Labor						62 00	
Office rent						64 00	
Miscellaneous						26 79	162 97
							$1,822 69

SURVEY RONDOUT CREEK.

Chapter 295, *Laws of* 1891.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.	Amount.
Martin Schenck	Assistant engineer in charge	6	$6 00 per day	$36 00	$21 49	$57 49	
R. C. Strachan	Leveler	1	4 50 per day	4 50	3 46	7 96	
J. H. Jones	Rodman	1	3 50 per day	3 50	3 46	6 96	
E. J. Waldron	Chainman	1	2 50 per day	2 50	3 46	5 96	
							$78 37
Incidental expenses.							
Labor						$17 50	
Miscellaneous						6 07	
							23 57
							$101 94

The foregoing tables are summarized as follows:

ORDINARY REPAIRS.			
Erie canal	$7,288 77		
Champlain canal	4,589 44		
		$11,878 21	
EXTRAORDINARY REPAIRS.			
Lengthening locks, Erie canal, chapter 168, Laws of 1890	$11,156 32		
Bottoming out Erie canal, chapter 168, Laws of 1890	388 85		
Bottoming out Albany basin, chapter 168, Laws of 1890	212 90		
Improving Champlain canal, chapter 168, Laws of 1890	9,971 10		
		21,729 17	
Main street bridge, Fultonville, chapter 149, Laws of 1889; chapter 333, Laws of 1890	$205 14		
Church street bridge, Schenectady, chapter 77, Laws of 1891	875 54		
Restoring Moyer creek, chapter 118, Laws of 1891	437 44		
Lift-bridge, Nineteenth street, West Troy, chapter 289, Laws of 1891	397 96		
		1,916 08	
SPECIAL SURVEY.			
Making surveys and maps required by State Engineer and Surveyor, chapter 295, Laws of 1890; chapter 302, Laws of 1891	$930 04		
Making surveys and maps for use of Attorney-General before State Board of Claims, chapter 295, Laws of 1890; chapter 302, Laws of 1891	3,352 55		
Survey of Saranac river, chapter 359, Laws of 1890	284 54		
Shinnecock and Peconic canal, chapter 436, Laws of 1890	1,822 69		
Survey of Rondout creek, chapter 295, Laws of 1891	101 94		
		6,491 76	
			$42,015 22

TABLE OF CONTRACTS ON EASTERN DIVISION COMPLETED DURING THE YEAR ENDING SEPTEMBER 30, 1891.

ERIE CANAL.

NAME OF CONTRACTOR.	Date of contract.	Character of work.	LEGISLATIVE ACT.		Appropriation.	Engineers estimate at contract prices	Final estimate.	Remarks.
			Chapter.	Year.				
Hughes Bros	July 23, 1890	Lengthening at the foot lock No. 40	168	1890	$185,000 00 For six or more locks.	$31,486 75	$30,980 81	
Hughes Bros	July 23, 1890	Lengthening at the foot lock No. 41	168	1890		29,422 05	28,399 22	
Casey, Murray & Co	July 18, 1890	Lengthening at the foot lock No. 42	168	1890		32,415 80	33,770 13	
Casey, Murray & Co	July 18, 1890	Lengthening at the foot lock No. 43	168	1890		31,377 50	30,853 86	
Nicholas & W. H. Wemple	July 17, 1890	Machinery for drawing boats into locks 40, 41, 42 and 43	168	1890		4,400 00	4,448 42	
Groton Bridge Mfg. Co	Oct. 17, 1890	Superstructure of iron bridge east of lock No. 42	168	1890		1,500 00	2,070 00	Bridge built with longer span than contemplated in preliminary.
P. W. Myers	Oct 9, 1890	Dredging Albany basin	168	1890	15,000 00	8,850 00	5,924 74	
Isaac Thomas	July 26, 1890	Substructure and approaches of bridge at Main st., Fultonville	149 333	1889 1890	10,000 00	3,532 25	4,447 69	
Rochester Bridge Works	July 26, 1890	Superstructure of bridge at Main street, Fultonville	149 333	1889 1890		4,359 00	4,359 60	
Flagler & Devlin	April 9, 1891	Substructure of bridge at Church street, Schenectady	77	1891	15,000 00	3,110 00	3,179 49	
Hilton Bridge Const'n Co.	April 6, 1891	Superstructure of bridge at Church street, Schenectady	77	1891		7,975 00	8,346 00	
Thomas & Nelson	Aug. 13, 1890	Comstructing apron, walls, etc, on Moyer creek, Frankfort	309	1889	Ord'ry rep's	... .	4,109 13	
Elec. Development Co	June 3, 1891	Bridge at Rotterdam street, Schenectady	266	1890	Ord'ry rep's	....	450 00	
						$158,428 35	$161,238 49	

CHAMPLAIN CANAL.

NAME OF CONTRACTOR.	Date of contract.	Character of work.	Chapter.	Year.	Appropriation.	Engineers estimate at contract prices	Final estimate.	Remarks.
Cunningham & Riley	Oct. 17, 1890	Improving 3,900 feet of canal north of Railroad street, lift-bridge, Mechanicville	168	1890		$29,889 00	$31,488 29	
Cunningham & Riley	Oct. 17, 1890	Rebuilding culvert under Champlain canal below Mechanicville	168	1890		5,597 30	6,982 48	

John W. Whalen.........	Oct. 15, 1890	Improving 1,400 feet of canal north of Mechanicville waste-weir..........	168	1890	110,000 00	5,708 75	4,868 29
John W. Whalen.........	Oct. 15, 1890	Improving 1,770 feet of canal south from Lansings' waste-weir..........	168	1890		10,144 25	9,729 58
John W. Whalen.........	Oct. 15. 1891	Improving 1,500 feet of canal north of Smiths' basin..........	168	1890		5,141 75	5,496 60
Jeremiah Adams.........	Feb. 16, 1891	Building vertical wall on Champlain canal in village of Whitehall..........	55	1889	80,000 00	3,812 70	3,440 14
						$59,293 75	$61,955 88

TABLE OF CONTRACTS PENDING ON THE EASTERN DIVISION ON THE 30TH DAY OF SEPTEMBER, 1891.

NAME OF CONTRACTOR.	Date of contract.	Character of work.	LEGISLATIVE ACT.		Appropriation.	Engineer's preliminary estimate.	Engineer's estimate at contract prices.	Payments to date.
			Chapter.	Year.				
Brummelkamp & Conron	July 27, 1891	Restoring and protecting the channel of Moyer creek	113	1891	$20,000 00	$18,099 00	$16,062 00	$4,607 00
Troy Public Works Co. (Ltd.)	Aug. 28, 1891	Improving 3,300 feet of Champlain canal, near Searle's waste-weir	168	1890	110,000 00	21,497 00	18,021 50	1,105 00
P. J. Brummelkamp	Oct. 7, 1890	The extension of the jetties of the Shinnecock canal and the dredging of the canal	436	1890	20,130 15	13,731 00	16,157 00	14,467 00
Milo B. Miller	Oct. 11, 1890	Building a wooden lock between Middle and Lower Saranac lakes	359	1890	5,000 00	4,500 00	4,500 00	3,500 00
Totals						$57,827 00	$54,740 50	$23,679 00

TABLE OF LOCKS — EASTERN DIVISION.

Erie Canal.

NUMBER.	DISTANCES. Lock to lock. Chains.	Links.	From Albany. Miles.	Lift in feet.
1	......	......	....	15.159
2	98	83	1.24	9.495
3	419	16	6.48	11.169
4	25	17	6.80	11.880
5	21	90	7.07	10.597
6	16	52	7.28	10.073
7	10	61	7.41	9.931
8	12	86	7.57	10.545
9	26	53	7.90	9.406
10	14	58	8.08	10.362
11	12	91	8.24	9.621
12	11	66	8.39	9.966
13	16	5	8.59	10.345
14	17	9	8.80	10.082
15	21	53	9.07	9.883
16	15	20	9.26	10.045
17	25	39	9.58	10.287
18	15	44	9.77	10.249
19	708	42	18.63	8.441
20	219	29	21.37	10.418
21	257	90	24.59	11.126
22	14	1	24.77	11.609
23 Berme lock lengthened at the foot	553	43	31.69	8.318
24 " " "	63	7	32.47	8.101
25 " " "	303	87	42.66	7.716
26 " " "	510	59	42.86	8.365
27 " " "	16	8	48.07	7.886
28 " " "	417	16	50.04	7.728
29 " " "	157	20	56.67	7.399
30 " " "	50	60	64.52	10.213
31 " " "	1,108	34	70.84	5.867
32 " " "	506	62	75.95	8.126
33 " " head	408	77	78.52	5.704
34 " " foot	205	63	81.70	8.483
35 " " "	254	23	86.07	7.785
36	349	20	86.68	10.019
37	49	52	86.85	9.898
38	12	87	87.06	8.733
39	17	35	89.82	10.534
40 Berme lock lengthened at the foot	220	82	92.46	8.524
41 " " "	211	11	95.32	8.286
42 " " "	228	99	95.32	7.954
43 " " "	20	59	95.58	8.069
44 " " "	216	16	98.28	10.787
45 " " " to county line	537	67	106.24	11.172

In addition to the above table are the following: Two double locks at West Troy side-cut, two single locks at Port Schuyler side-cut, one weigh-lock at Albany, one weigh-lock at West Troy.

NOTE.— Locks are eighteen feet wide at water surface of lower level with a batter of one-half inch to the foot on each wall and 110 feet long from center to center of hollow quoins. Lengthened locks are 221 feet long from center to center of hollow quoins. The new portion of all lengthened locks is twenty feet wide at water surface of lower level.

TABLE OF AQUEDUCTS — EASTERN DIVISION — ERIE CANAL.

Number.	NAME.	DISTANCE WEST OF LOCK.			Interior width.		Number of spans.	Total length chains	ELEVATION.		
		Chains.	Links.	Lock No.	Ft.	In.			Spillway.	Flush board.	Bottom.
1	Lower Mohawk	220	52	18	40	6	26	17.23	+6.90	None.	....
2	Upper Mohawk	6	60	22	44	4	14	9.25	+6.65	None.	....
3	Flat Stone creek (Van Slyke)	113	97	24	49	0	3	1.13	+6.70	+7.17	−0.5
4	Sausai kill (Hoffman's)	171	9	25	52	0	4	1.55	+6.97	+7.67	−0.8
5	Schoharie creek	8	97	30	40	6	14	9.46	+7.67	None	−0.2
6	Tokkon creek	664	91	30	51	4	4	1.53	+7.81	None	−0.5
7	Leonardson creek (Yatesville)	846	38	30	51	0	4	1.53	+6.71	+7.88	−0.7
8	Lashers	934	92	30	50	0	3	1.13	+6.96	+7.40	−0.4
9	Plattskill (Sprakers)	5	77	31	50	0	5	1.94	+6.71	+7.03	−0.8
10	Bauman's creek (Canajoharie)	251	97	31	50	0	5	1.94	+6.94	+7.24	−0.2
11	Otsquago creek (Fort Plain)	18	31	32	50	0	5	1.91	+6.55	None.	−0.7
12	Castle creek (Indian Castle)	7	1	35	50	6	5	1.94	+7.28	+7.63	−0.1
13	Fulmer's creek (Mohawk)	2	72	43	65	6	3	1.12	+6.86	+7.07	−0.3
14	Steele's creek (Ilion)	120	4	43	51	6	2	.74	+6.85	+7.09	−0.6
15	Moyer creek (Frankfort)	2	74	45	66	0	2	.74	+6.79	None.	−0.7
16	Furguson's creek	452	35	45	55	0	1	.33	+7.22	None.	−0.9

TABLE OF WASTE-WEIRS — EASTERN DIVISION — ERIE CANAL.

NUMBER.	LOCATION WEST OF LOCK.			OPENINGS.				SPILLWAY.		Elevation of flush boards.	Remarks.
	Chains.	Links.	Lock No	Number of.	SIZE.		Elevation, bottom.	Length.	Elevation.		
					High.	Wide.					
					Ft. In.	Ft. In.		Ft In.			
1............ ..	308	30	2	4	4 2	2 6	− 0.2	33 0	+ 6.90	+ 7.67	
2..............	312	57	2	....	....	....	....	45 2	+ 6.15	+ 8.49	No gates in use.
3............ ...	West Troy basin..................			4	3 0	3 0	1.0	16 0	....	.. ....	
4..............	22	67	3	10	2 6	2 0	− 1.8	29 10	+ 7.38	None.	
5	10	58	9	2	3 1	3 0	− 1.3	12 8	+ 7.58	None.	
6..............	18	40	18	4	3 2	2 9	− 2.1	27 2	+ 7.25	None.	
7..............	12	20	20	....	....	....	....	....	....	....	Abandoned.
8..............	368	46	22	....	....	....	....	....	....	....	Abandoned.
9..............	163	84	27	3	3 11	2 10	− 1.9	10 1	+ 7.02	None.	
10..............	1,097	9	30	3	4 8	3 5	− 1.2	11 11	+ 7.81	None.	
11..............	182	38	32	1	3 4	3 8	....	....	....	None.	
12..............	6	50	33	3	3 0	2 9	+ 3.2	17 7	+ 7.05	+ 8.05	
13..............	38	25	33	3	2 8	3 4	− 0.8	9 10	+ 8.00	None.	
14..............	286	2	35	5	2 0	2 10	− 1.0	14 0	+ 6.89	+ 7.94	
15..............	2	50	36	2	2 4	4 10	+ 4.9	10 0	+ 8.18	None.	
16..............	16	52	39	4	3 1	2 0	+ − 0.0	70 0	+ 8.43	None.	
17..............	13	2	40	....	....	....	....	....	....	....	Abandoned.
18..............	10	64	41	4	2 6	2 2	− 1.9	79 6	+ 6.82	+ 7.20	Only two gates in use.

TABLE OF CULVERTS — EASTERN DIVISION — ERIE CANAL.

Number.	Distance in chains and links.	CLASS.	Number of openings.	Size of opening.	Elevation of top of opening.	Remarks.
				West of lock No. 1.		
1	31.00	Stone arch	3	10 feet chord, 4 feet 8 inches rise.........	1.25	Connected with sewer on each end.
2	60.75	" (diving)	1	4 feet chord	......	Connected with sewer on each end.
				West of lock No. 2.		
3	89.00	Stone arch (diving)	1	9 feet chord	4.7	
4	97.28	" "	....	9 feet chord	4.7	
5	138.50	Stone box "	1	6 feet 4 inches wide, 2 feet 6 inches high..................	2.9	
6	167.00	Stone arch "	2	7 feet chord	6.25	
7	189.40	Stone (diving)........... .	....	....	.... .	Connected with sewer on towpath end.
8	276.45	"	....	....	......	Connected with sewer on both ends.
9	313.25	Stone arch	2	9 feet chord, 4 feet rise	4.5	
10	398.30	Stone box (diving).......	1	6 feet 6 inches wide. 3 feet 5 inches high	......	
				West of lock No. 3.		
11	....	Stone arch (diving)......	1	6 feet arch, 3 feet rise	1.2	
				West of lock No. 6.		
12	....	Stone arch	1	12 feet chord, 6 feet rise, 7 feet bench walls...............	8.25	
				West of lock No. 9.		
13	....	Stone arch	1	8 feet 4 inches chord, 4 feet 2 inches rise, 2 feet 7 inches bench walls	18.20	
				West of lock No. 13.		
14	....	Stone arch	....	7 feet 6 inches chord. 3 feet 9 inches rise, 2 feet bench walls.	......	Connected with sewer on both ends.
				West of lock No. 17.		
15	....	Stone arch (diving)......	1	4 feet chord	6.91	Connected with sewer.
				West of lock No 18.		
16	28.65	Stone arch	1	8 feet chord, 4 feet rise, 3 feet bench walls.................	......	
17	187.50	Stone box (diving).......	1	....	.. ...	Connected with road culvert on towpath end.
18	250.54	Stone arch	1	8 feet chord, 4 feet rise, 5 feet 6 inches bench walls........	5.0	
19	438.55	"	1	6 feet chord. 3 feet rise..	4.0	
20	515.54	" (diving)	....	....	2.9	
21	651.95	Stone box "	1	3 feet rise, 4 feet high........................	0.3	

				West of lock No. 19.		
22	65.90	Stone arch	1	10 feet 6 inches chord, 5 feet 3 inches rise, 5 feet 6 inches bench walls	7.74	
				West of lock No. 22.		
23	5.60	Stone arch for feeder	1	28 feet chord, 14 feet bench walls..........................	7.4	
24	203.66	Stone arch	1	7 feet chord, 2 feet rise, 4 feet bench walls.................	4.5	
25	277.50	Stone arch (diving)......	....	18 feet chord, 2 feet 6 inches rise..........................	4.5	
26	349.95	Stone arch	1	14 feet chord, 5 feet rise, 2 feet bench walls...............	5.7	
27	412.25	"	1	5 feet 6 inches chord, 2 feet 9 inches rise, 2 feet bench walls.	7.0	
28	464.50	"	1	12 feet chord, 6 feet rise, 2 feet 6 inches bench walls.......	5.67	
				West of lock No. 24,		
29	12.00	Stone arch	1	7 feet chord, 3 feet 6 inches rise, 1 foot 6 inches bench walls	15.40	
30	149 40	"	1	7 feet chord. 3 feet 6 inches rise, 4 feet bench walls........	20.25	
31	174.12	"....	1	11 feet chord, 5 feet 6 inches rise, 3 feet bench walls.......	7.50	
				West of lock No. 25.		
32	154.60	Stone box	1	2 feet 6 inches wide, 2 feet 10 inches high...................	3.0	
33	218.08	Stone arch...............	1	4 feet chord, 2 feet rise, 2 feet bench walls.................	4.0	
34	269.90	Composite box	1	2 feet wide, 1 foot 2 inches high............................	4.0	
35	360.70	Stone arch	1	4 feet chord, 2 feet rise....................................	4.7	
36	’01.20	"	1	10 feet chord, 2 feet 6 inches rise..........................	7.3	
				West of lock No. 27.		
37	3.18	Stone arch...............	2	18 feet chord, 3 feet rise, 2 feet 6 inches bench walls	5.1	
38	61.45	"	1	7 feet chord, 3 feet 6 inches rise, 4 feet 6 inches bench walls	4.9	
39	96.40	"	1	4 feet chord, 2 feet rise. 1 foot bench walls	3.4	
40	163.84	"	1	6 feet chord, 3 feet rise, 2 feet bench walls................	7.2	Combined with waste-weir.
41	207.00	Stone box	1	....	......	
42	225.17	Stone arch	4	20 feet chord, 4 feet rise, 3 feet bench walls...............	4.5	
				West of lock No. 28.		
43	5.24	Stone arch	1	6 feet chord, 3 feet rise....................................	......	
44	85.20	"	1	4 feet chord, 2 feet rise, 1 foot bench walls................	5.6	
45	140.00	Stone diving.............	....	....	......	
				West of lock No. 30.		
46	71.50	Stone arch	1	4 feet chord, 2 feet rise....................................	3.8	
47	146.20	"	2	10 feet chord, 3 feet 2 inches rise, 2 feet bench walls	5.4	
48	170.50	"	4	28 feet 3 inches chord, 4 feet rise, 5 feet bench walls.......	3.1	
49	282.50	"	1	4 feet chord, 2 feet rise....................................	4.1	
50	336.00	"	1	4 feet chord, 2 feet rise....................................	4.1	
51	400.25	"	2	9 feet chord	2.8	
52	427.10	"	1	4 feet chord, 2 feet rise....................................	3.8	
53	707.40	"	1	4 feet chord, 2 feet rise, 2 feet bench walls................	3.5	
54	807.60	"	1	4 feet chord, 2 feet rise, 1 foot 6 inches bench walls........	3.5	
55	1,096.55	"	1	4 feet chord	4.1	

TABLE OF CULVERTS — EASTERN DIVISION — ERIE CANAL — (*Concluded*).

Number.	Distance in chains and links.	CLASS.	Number of openings.	Size of opening.	Elevation of top of opening.	Remarks.
				West of lock No. 31.		
56	32.65	Stone arch	1	8 feet chord, 2 feet rise	4.5	
57	224.80	"	1	4 feet chord, 2 feet rise	4.0	
58	294.36	"	1	5 feet chord	4.5	
59	377.70	"	1	12 feet chord	4.6	
				West of lock No. 32.		
60	78.00	Stone box	1	2 feet by 2 feet	......	
61	122.00	Stone arch	1	12 feet chord, 2 feet 6 inches rise	3.1	
62	140.00	"	1	3 feet chord	6.3	
63	243.49	"	1	7 feet chord, 2 feet 6 inches rise	......	
....	314.84	"	....		......	Abandoned.
				West of lock No. 33.		
64	29.20	Stone arch	1	6 feet chord, 3 feet rise, 12 inches bench walls	3.1	
....	172.35	Wooden box	....		......	Abandoned.
				West of lock No 34.		
65	210.00	Diving	....		......	
66	....	Rocky rift under Castle creek	....	3 feet wide, 6 feet high	......	
				West of lock No. 35.		
....	92.00	Stone culvert	....		......	Abandoned.
67	222.36	Stone arch (diving)	1	8 feet chord	1.0	
68	286.02	Stone arch	....		......	Combined with waste-weir.
				West of lock No. 39.		
69	155.08	Composite box (diving)	2	5 feet 9 inches wide. 2 feet 6 inches high	2.6	
70	199.74	Stone arch (diving)	1	8 feet chord, 1 foot 6 inches rise, 2 inches bench walls	2.7	
				West of lock No. 40.		
71	8.00	Stone arch (diving)	1	3 feet chord	4.0	
72	107.80	Composite box (diving)	1	3 feet wide, 3 feet high	2.1	
73	147.20	Stone box (diving)	1	3 feet wide, 2 feet high	3.6	
				West of lock No. 41.		
74	7.12	Stone arch	2	6 feet chord, 1 foot 6 inches rise, 2 feet 6 inches bench walls	4.1	

				West of lock No. 43.		
75	26.75	Stone box (diving)	2	4 feet 6 inches wide, 2 feet 6 inches high..................	4.3	
76	77.60	Stone arch	1	3 feet chord, 1 foot 6 inches rise, 12 inches bench walls....	5.1	Connected with sewer on berme.
77	191.10	"	1	7 feet chord, 3 feet 6 inches rise, 2 feet bench walls........	4.9	
78	207.57	Stone arch (diving)	1	8 feet chord, 1 foot 6 inches rise, 2 feet 9 inches bench walls	4.2	
				West of lock No. 44.		
79	72.65	Stone (diving)	....	....	......	
				West of lock No. 45		
80	118.65	Stone arch	1	12 feet chord, 2 feet 9 inches rise, 8 feet bench walls	4 5	
81	285.70	Stone box	1	2 feet wide, 2 feet high	6.4	
82	370.00	"	1	2 feet 6 inches wide, 2 feet high..........................	13.0	
83	397.30	"	1	2 feet 6 inches wide, 2 feet high..........................	10.2	
84	468.60	Stone arch	1	4 feet chord, 2 feet rise, 2 feet bench walls.................	6.2	

TABLE SHOWING BRIDGES ON THE EASTERN DIVISION, WITH THEIR LOCATION, SPAN AND STYLE OF SUPERSTRUCTURE.

Erie Canal.

Numbers.	Distance in chains.	Name.	Class.	CHARACTER OF TRUSS.	Clear span.	Number of panels.	Span out to out of panel points.	ROADWAY.		SIDEWALKS.		Skew.	When built or re-built.
								Number.	Width, clear.	Number.	Width.		
				West of lock No. 1.	′ ″		′ ″		′ ″		′ ″		
1	......	Water street	Street	Cast-iron arch (two spans)	47.6	5	48.8	1	15.9	2	5.1	16° 0′ L	
2	11.58	Lawrence street	Street	Wrought-iron swing	111.5	12	111.5	1	16.5	1	4.4	....	
3	16.78	Ferry street	Street	Wrought-iron lift	84.1½	10	107.10¾	1	22.0	2	6.5	20° 0′ R	1889
4	53.62	Bridge street	Street	Wrought-iron lattice	89.9	9	94.4	1	19.8	....	....	....	1889
4A	82.90	Erie street	Foot	Suspension	104.0	....	....	....	....	1	6.0	....	1886
				West of lock No. 2.									
5	47.67	....	Road	Whipple wooden	71.8	6	78.1	1	11.0	....	....	....	
....	89.85	Breaker island	D. & H R. R.	Wrought-iron lattice, riveted	127.2	10	135.8	....	....	....	....	21° 30′ L	1886
6	114.14	Gowey's lane	Road	Whipple wooden, with wrought-iron lower chords	72.2	6	74.5	1	11.4	....	....	....	1889
7	134.63	Menands	Road	Cast-iron arch	79.0	9	81.0	1	15.9	....	....	....	
8	157.21	....	Road	Whipple wooden	81.7	8	83.8	1	18.0	....	....	....	
9	186.21	....	Road	Whipple wooden, with wrought-iron lower chords	83.0	8	85.7	1	18.3	....	....	....	
10	215.44	Schuyler's lane	Street	Whipple wooden, with wrought-iron lower chords	88.0	6	84.10	1	14.1	....	....	....	
11	243.54	Fifth street	Street	Whipple wooden, with wrought-iron lower chords	76.7	8	79.0	1	16.6	1	5.10	14° 30′ L	1890
12	251.65	Sixth street	Foot	Wrought-iron pin and link	98.0	7	93.0	....	....	1	7.10	....	1886
13	260.97	Seventh street	Street	Whipple wooden, with wrought-iron lower chords	82.11	6	84.9	1	15.6	....	....	2° 30′ L	1890
14	269.02	Ninth street	Street	Warren wrought-iron, riveted	97.6	12	104.0	1	17.0	2	4.8	34° 0′ L	
....	285.50	United States arsenal.	Railroad	Wrought-iron, riveted	....	....	....	....	....	....	....	....	1889
....	290.00	United States arsenal.	Road	Wooden lattice	....	....	....	....	....	....	....	....	
....	302.00	United States arsenal.	Road	Cast-iron arch	....	....	....	....	....	....	....	....	
15	312.57	Thirteenth street	Street	Cast-iron arch	91.0	9	92.8	1	15.4	2	5.4	....	
16	320.93	Fourteenth street	Street	Cast-iron arch	80 10	9	82.2	1	14.6	2	6.3	....	
17	339.03	Sixteenth street	Street	Wrought-iron arch	84.4	8	87.9	2	17.9	2	6.7	....	
18	350.34	Nineteenth street	Street	Cast-iron arch	82.6	9	85.0	1	16.6	2	6.0	....	
19	363.38	Tow-path change	Change.	Wrought-iron pipe	94.4	9	97.6	1	8.3	....	....	....	
20	365.69	Twenty-third street	Street	Cast-iron pipe arch	79.8	7	81.3	1	15.0	2	6.0	....	
21	379.99	Twenty-fifth street	Street	Cast-iron arch	81.6	9	82.6	1	16.4	2	5.9	....	

....	401.21	Del. & Hud. R. R.	Railroad	Warren wrought-iron, riveted	....	....	....	....	....	....	....	....	
....	401.21	N. Y. Central R. R.	Railroad	Warren wrought-iron, riveted	....	....	....	....	....	....	....	....	
22	415.45	Road and change	Road & change	Whipple trapezoidal, cast-iron	120.9	10	124.0	1	15.9	1	8.0	26° 30′ L	
				West of lock No. 3.									
....	22.67	Del. & Hud. R. R.	Railroad	Wrought-iron, riveted	....	....	....	....	....	....	....	....	
				West of lock No. 4.									
23	3.00	Road	Road	Towne wooden lattice	109.5	8	120.5	1	12.2	....	....	....	
				West of lock No. 8.									
24	21.50	Highland avenue	Street	Cast-iron arch	109.4	11	114.0	1	15.0	1	6.6	....	
				West of lock No. 12.									
25	8.00	Columbia avenue	Street	Cast-iron arch	110.3	11	113.10	1	15.2	2	7.8	....	
				West of lock No. 13.									
26	8.00	High street	Street	Whipple trapezoidal, cast iron	109.5	12	112.6	1	14.9	2	6.0	....	
				West of lock No. 15.									
27	11.20	Vliet street	Street	Whipple trapezoidal, cast iron	120.5	12	125.5	1	15.2	2	6.6	....	
....	11.50	Vliet street	Water mains	Wrought-iron arch, riveted	121.0	12	....	....	....	....	....	....	
				West of lock No. 17.									
28	11.44	....	Farm	Whipple wooden, with wrought-iron lower chords	101.1	10	103.1	1	14.3	....	....	....	1888
				West of lock No. 18.									
29	14.00	Road and change	Road & change	Whipple cast-iron arch	79.11	7	82.9	1	13.0	1	6.4	....	
30	57.22	Cement Mill	Farm	Whipple wooden	71.0	6	72.9	1	11.10	....	....	....	
31	128.28	Wide Water	Farm	Whipple wooden	72.4	6	74.7	1	11.9	....	....	....	
32	169.21	Jesse Fonda	Farm	Whipple wooden	70.4	6	72.3	1	11.10	....	....	....	
33	218.08	Aqueduct change	Road & change	Cast-iron arch	71.8	7	73.0	1	13.6	1	8.0	....	
34	244.30	Crescent road	Road	Whipple wooden, with wrought-iron lower chords	85.8	8	88.10	1	15.6	....	....	....	
....	250.67	....	Foot	Suspension	82.7	....	....	....	....	....	....	....	
....	251.06	Noxon's Dry Dock	Road	Draw-bridge, wooden	22.0	....	....	1	11.2	....	....	....	
....	274.80	....	Foot	Suspension	....	....	....	....	....	....	....	....	
....	303.80	....	Foot	Suspension	....	....	....	....	....	....	....	....	
....	315.30	....	Foot	Suspension	....	....	....	....	....	....	....	....	
35	340.21	Newtons	Farm	Whipple wooden	71.2	6	73.0	1	11.9	....	....	....	
36	369.14	Wonderford	Farm	Whipple wooden, with wrought-iron lower chords	71.1	6	73.1	1	15 9	....	....	....	
37	432.46	Dunsback	Road	Whipple wooden	71.4	6	72.11	1	11.9	....	....	....	
38	512.10	Clute's	Road	Whipple wooden, with wrought-iron lower chords	89.10	8	92.4	1	15.10	....	....	....	
39	521.17	Clute's	Farm	Whipple wooden, with wrought-iron lower chords	69.10	6	73.1	1	12.8	....	....	....	
40	543.70	Pearse's	Road	Whipple wooden, with wrought-iron lower chords	70.7	6	72.7	1	11.11	....	....	....	1889

TABLE SHOWING BRIDGES ON THE EASTERN DIVISION, ETC.—ERIE CANAL—(*Continued*).

Number.	Distance in chains.	Name.	Class.	CHARACTER OF TRUSS.	Clear span.	Number of panels.	Span out to out of panel points.	ROADWAY.		SIDEWALK.		Skew.	When built or rebuilt.
								Number.	Width clear.	Number.	Width.		
				West of lock No 18.—(Concluded).	′ ″		′ ″		′ ″		′ ″		
41	568.09	Van Vranken	Farm	Whipple wooden	71.7	6	73.7	1	12.1	....	....	....	
42	598.59	Whiteheads	Road	Wrought-iron pin and link	70.1	6	73.6	1	14.10	....	....	....	
43	633.80	Clute's	Farm	Whipple wooden, with wrought-iron lower chords	69.6	6	72.11	1	11.11	....	....	....	
44	642.27	Pearse	Farm	Whipple wooden	72.7	6	74.1	1	12.0	....	....	....	
45	658.55	Van Vranken	Farm	Whipple wooden	71.3	6	73.0	1	11.11	....	....	....	
46	693.57	McDermott	Farm	Whipple wooden	73.0	6	74 2	1	12.1	....	....	....	
				West of lock No. 19.									
47	69.70	Vischer's Ferry	Road	Whipple wooden, with wrought-iron lower chords	74.6	6	77.1	1	13.10	....	....	8° 30′ L	
				West of lock No. 20.									
48	108.92	Funda's basin	Farm	Whipple wooden, with wrought-iron lower chords	72.4	6	74.6	1	12.8	....	....	34° 30′ R	
49	255.30	Feeder bridge	Tow-path	Whipple wooden	42.11	6	44.9	1	11.11	....	....	....	
				West of lock No. 21.									
50	12.24	Aqueduct change	Road & change	Wrought-iron arch, riveted	93.1	8	96.0	1	12.4	....	....	....	
				West of lock No. 22.									
51	24.47	Aqueduct	Highway	Whipple wooden, with wrought-iron lower chords	72.5	6	74.8	1	12.7	....	....	....	.....
52	143.04	Vedder	Farm	Whipple wooden, with wrought-iron lower chords	72.2	6	75.1	1	12.1	....	....	....	.....
53	161.80	Cunningham	Farm	Whipple wooden, with wrought-iron lower chords	70.8	6	73 0	1	12.2	....	....	....	.....
.....	214.00	D. and H. R. R.	Railroad	Wrought-iron riveted lattice	95.0	....	....	....	....	....	....	21° 0′ R	....
54	230.28	Freeman	Highway	Whipple wooden, with wrought-iron lower chords	72.5	6	74.8	1	15.1	....	....	9° 20′ R	.....
55	265.00	....	Road	Whipple wooden	79.4	6	81.0	1	14.6	....	....	26° 20′ L	.....
.....	284.49	Front street	Street	Wrought-iron swing	81.1	11	117.5	1	21.6	....	....	....	.....
56	305.02	Jefferson street	Street	Whipple wooden, with wrought-iron lower chords	80.8	6	83.8	1	16.4	2	7.10	21° 50′ R	.....
57	311.56	Green street	Street	Cast-iron arch	93.3	9	93.6	1	16.5	1	6.2	37° 10′ L	.....

.....	319.10	N. Y. C.	Railroad	Wrought-iron lattice riveted	152.00	13	....	....	....	....	....	31° 20′ R	.....
58	323.98	Union	Street	Cast-iron arch	90.2	9	92.3	2	17.1	2	8.8	34° 0′ L	.....
59	331.46	Liberty	Street	Wrought iron riveted trapezoidal	81.10	7	87 2	1	20.0	2	5.6	25° 0′ L	1890
60	337.72	State	Street	Wrought iron riveted trapezoidal	73.6	6	78.0	2	14.3	2	14.0	....	1891
61	354.24	Church	Street	Wrought-iron riveted trapezoidal, lift	63.3	8	82.10½	1	24.0	2	5.3	....	1891
62	366.07	Rotterdam	Street	Wrought-iron riveted trapezoidal	77.9	7	86.10½	1	23.0	2	5.3	21° 0′ R	1891
63	504.50	Navarine bay	Farm	Whipple wooden, with wrought iron lower chords	69.7	6	72.0	1	11.11	....	....	....	.....
				West of lock No. 23.									
64	9.01	Schermerhorn	Farm	Wrought-iron arch	70.5	6	72.4	1	12.10	....	....	....	1888
				West of lock No. 24.									
65	49.83	Beckers	Road	Wrought-iron pin and link	78.7	7	81.4	1	15.9	....	....	24° 30′ L	.....
66	99.38	Van Slyke's	Road	Whipple wooden, with wrought-iron lower chords	80.9	6	83.11	1	15.6	....	....	28° 30′ R	1886
.....	126.50	Private	Farm	Whipple wooden	82.6	....	....	....	....	....	....	....	.....
67	181.54	Crawford's	Road	Whipple wooden, with wrought-iron lower chords	76.6	6	80.3	1	16.0	....	....	24° 0′ L	.....
68	218.15	....	Farm	Whipple wooden, with wrought-iron lower chords	70.2	6	73.1	1	11.10	....	....	....	1888
69	294.47	Bradt's	Farm	Whipple wooden	71 8	6	73.7	1	12.0	..	....	....	1888
.....	296.46	Fitchburg	Railroad	Wrought-iron lattice riveted	119.0	....	....	....	....	....	....	....	.....
				West of lock No. 25.									
70	9.38	Clute	Farm	Whipple wooden, with wrought-iron lower chords	71.10	6	74.3	1	12.3	....	....	....	.....
71	40.38	Turnbull	Farm	Whipple wooden, with wrought-iron lower chords	71.0	6	73.0	1	11.8	....	....	....	1886
72	74.89	....	Road	Whipple wooden, with wrought iron lower chords	70.0	6	72.0	1	12.1	....	....	23° 40′ R	1886
73	117.58	....	Road	Wrought iron triangular riveted	77.2	10	80.0	1	14.3	....	....	....	.....
74	185.89	Patterson	Road	Whipple wooden, with wrought-iron lower chords	70.6	6	74.8	1	12.0	....	....	....	.....
75	398 64	French	Farm	Whipple wooden, with wrought-iron lower chords	72.7	6	74.5	1	12.0	....	....	....	1889
76	460.10	....	Farm	Whipple wooden, with wrought-iron lower chords	74.10	6	78.0	1	12.1	....	....	....	1891
				West of lock No 26.									
77	12.67	Phillips	Farm	Whipple wooden, with wrought-iron lower chords	86.3	6	89.0	1	12.2	....	....	....	.....
				West of lock No. 27.									
78	208.20	River street	Street	Cast-iron arch	72.0	6	75.0	1	16.7	1	6.2	....	1886
79	211.32	Bridge street	Street	Cast-iron arch	75.4	7	77.8	1	16.3	1	....	12° 30′ R	.....

TABLE SHOWING BRIDGES ON THE EASTERN DIVISION, ETC.—ERIE CANAL—(*Continued*).

Number.	Distance in chains	NAME.	Class.	Character of truss.	Clear span.	Number of panels.	Span out to out of panel points.	ROADWAY.		SIDEWALK.		Skew.	When built or re-built.
								Number.	Width, clear.	Number.	Width.		
				West of lock No. 28.	′ ″		′ ″		′ ″		′ ″		
80	138.11	Voorhees	Farm	Whipple wooden	71.0	6	73.1	1	12.0	....	....	....	.....
				West of lock No. 29.									
81	30.11	....	Road	Whipple wooden, with wrought-iron lower chords	83.10	7	87.5	1	11.11	....	....	....	1890
82	47.12	Fort Hunter	....	Cast-iron arch	97.0	9	98.3	1	16.3	....	....	....	.....
				West of lock No. 30.									
83	51.75	Hudson	Farm	Whipple wooden	70.11	6	71.11	1	12.1	....	....	....	.....
84	123.44	Auriesville	Road	Whipple wooden	82.9	7	84.10	1	12.0	....	....	....	1886
85	152.39	Auriesville	Farm	Whipple wooden	83.9	6	84.9	1	12.2	....	....	....	.....
86	181.20	Voorhees	Farm	Whipple wooden, with wrought-iron lower chords	71.4	6	73.2	1	12.1	....	....	....	.....
87	219.80	Coon	Farm	Whipple wooden	85.10	6	88.5	1	12.0	....	....	....	.....
88	253.48	Quackenbush	Farm	Whipple wooden, with wrought-iron lower chords	81.6	7	84.4	1	12.4	....	....	....	1890
89	280.71	County house	Road	Wrought-iron riveted	81.0	7	84.0	1	17.4	....	....	....	1887
90	306.17	Vrooman	Farm	Whipple wooden	69.10	6	71.11	1	12.0	....	....	....	.....
91	345.12	Sandy Hill	Road	Whipple wooden, with wrought-iron lower chords	66.4	6	70.1	1	11.10	....	....	....	.....
92	398.70	Canal street	Street	Wrought-iron riveted trapezoidal	70.8	7	75.2	1	17.5	....	....	....	1886
93	412.02	Main street	Street	Wrought-iron riveted lattice	81.0	7	85.6	2	14.0	2	6.6	9° 30′ R	1891
94	421.07	Steam mill	Street	Cast-iron arch	76.0	7	77.7	....	16.9	....	....	....	1886
95	482.77	Snyders	Farm	Whipple wooden	71.2	6	73.1	1	12.0	....	....	....	.....
96	538.58	Sturm	Farm	Whipple wooden	72.4	6	73.1	1	11.11	....	....	....	.....
97	612.63	Printy	Farm	Whipple wooden	71.3	6	78.0	1	12.2	....	....	....	.....
98	737.00	Yates	Farm	Whipple wooden	71.7	6	73.2	1	12.0	....	....	....	.....
99	783.63	Downings	Farm	Whipple wooden	71.2	6	73.1	1	12.0	...	....	....	.....
100	828.13	M. Yates	Farm	Whipple wooden	71.1	6	73.1	1	12.0	....	....	....	1886
101	928.63	A. Yates	Farm	Whipple wooden, with wrought-iron lower chords	73.0	6	75.1	1	12.2	....	....	....	1891
101A	941.15	Downing	Road	Wrought-iron pin and link	92.10	8	96.0	1	15.7	....	....	....	.....
101B	1023.15	Downing	Road	Wrought-iron pin and link	102.0	9	105.0	1	15.0	....	....	25° 50′ R	.....
102	1079.20	Mitchells	Farm	Whipple wooden	69.8	6	72.1	1	13.1	....	....	....	.....

				West of lock No. 31.									
103	......	Sprakers	Road	Whipple wooden	71.2	6	73.1	1	12.2	....	....	....	.....
104	......	Ferry street	Street	Cast-iron arch	72.1	7	73.11	1	13.10	....	....	....	.....
105	......	Van Evera	Farm	Whipple wooden, with wrought-iron lower chords	74.11	6	78.4	1	12.0	....	....	....	1889
106		Kelly	Farm	Whipple wooden	71.8	6	73.1	1	11.11	....	....	....	.....
107	......	A. Van Alstyne	Farm	Whipple wooden, with wrought iron lower chords	70.4	6	72.11	1	11.11	....	....	....	1890
108	......	L Van Alstyne	Farm	Whipple wooden	71.4	6	73.5	1	11.11	....	....	....	.....
109	......	Bullock	Farm	Whipple wooden	79.11	6	82.4	1	12.0	....	....	....	1886
110	......	Main street	Street	Cast-iron arch	82.0	9	83.0	1	16.10	2	7.3	11° 20 R	.....
.....	......	Private	Foot	Suspension	....	....	....	....	....	....	....	....	.....
111	......	Allen	Farm	Whipple wooden	71.1	6	73.5	1	12.0	....	....	....	.....
112	......	Wagner	Farm	Whipple wooden	70.10	6	73.1	1	12.0	....	....	....	1886
113	......	Nellis	Road	Whipple wooden with wrought-iron lower chords	72.0	6	75.0	1	12.3	....	....	....	1891
.....	......	West Shore	Railroad	Wrought-iron pin and link	185.6	....	....	....	....	....	....	30° 0'	.....
				West of lock No. 32.									
114	10.95	Morell	Street	Whipple wooden	71.0	6	72.0	1	12.0	....	....	....	.....
114A	22.62	Main street	Street	Wrought-iron lift	76.6	7	97.10	1	19.0	....	....	17° R	1888
115	22.95	Main street	Foot	Suspension	145.6	....	....	....	....	1	5.8	....	.....
116	28.21	River street	Street	Cast-iron pipe arch	70.4	7	76.0	1	16.2	2	6.4	9° 0' R	.....
117	59.64	Clark street	Street	Whipple wooden	71.9	6	73.5	1	12.0	....	....	....	1886
118	89.98	Lipe	Farm	Whipple wooden, with wrought-iron lower chords	70.9	6	72.11	1	12.1	....	....	....	.....
.....	111.98	West Shore	Railroad	Wrought-iron pin and link	185.1	12	....	....	....	....	....	....	.....
119	337.28	Smith	Farm	Whipple wooden	71.8	6	73.1	1	12.0	....	....	....	.....
				West of lock No. 33.									
120	23.79	Powell	Farm	Whipple wooden	71.7	6	73.0	1	12.0	....	....	....	.....
121	66.08	Cox	Road	Whipple wooden, with wrought-iron lower chords	82.0	8	86.0	1	16.8	....	....	7° 40' R	.....
122	......	Abandoned	....	....	....	....	....	....	....	....	....	....	.....
123	196.10	Crounse	Farm	Whipple wooden	70.10	6	72.0	1	11.10	....	....	....	.....
				West of lock No. 34.									
124	8.19	Mindenville	Road	Whipple wooden, with wrought-iron lower chords	73.3	6	75.1	1	13.4½	....	....	1° 30' L	1887
125	45.50	Brazee	Farm	Whipple wooden, with wrought-iron lower chords	85.7	7	87.6	1	12.0	....	....	10° 40' R	1887
126	71.69	Snell	Farm	Whipple wooden, with wrought-iron lower chords	72.2	6	74.5	1	12.2	....	....	....	1889
127	94.17	East creek landing	Road	Whipple wooden, with wrought-iron lower chords	71.10	6	74.5	1	12.4	....	....	....	.....
128	128.45	Smith	Farm	Whipple wooden	71.10	6	74.0	1	12.1	....	....	....	.....
129	174.08	Van Alstyne	Farm	Whipple wooden	71.7	6	73.7	1	12.1	....	....	....	.....
130	217.51	Jones	Farm	Whipple wooden, with wrought-iron lower chords	72.11	6	74.10	1	12.0	....	....	....	1889

TABLE SHOWING BRIDGES ON THE EASTERN DIVISION, ETC.—ERIE CANAL—(*Continued*).

Number.	Distance in chains.	NAME.	Class.	Character of truss.	Clear span.	Number of panels.	Span out to out of panel points.	ROADWAY. Number.	ROADWAY. Width clear.	SIDEWALK. Number.	SIDEWALK. Width.	Skew.	When built or re-built.
				West of lock No. 34—(Concluded).	′ ″		′ ″		′ ″		′ ″		
131	241.53	Green	Farm	Whipple wooden, with wrought-iron lower chords	71.9	6	74.0	1	12.5	....	....	....	1891
				West of lock No. 35.									
132	34.98	Fox	Farm	Whipple wooden, with wrought-iron lower chords	71.10	6	74.0	1	12.9	....	....	....	1891
133	71.24	Kintzinger	Farm	Whipple wooden, with wrought-iron lower chords	72.8	6	76.9	1	12.0	....	....	....	.....
134	216.58	Herkimer	Farm	Whipple wooden, with wrought-iron lower chords	71.11	6	74.7	1	12.0	....	....	....	.....
135	290.56	Fink's basin	Road	Whipple wooden, with wrought-iron lower chords	73.1	6	76.3	1	11.11	....	....	13° 40′ L	.....
				West of lock No. 38.									
136	7.38	German street	Street	Cast-iron pipe arch	72.10	7	75.3	1	14.4	2	6.0	19° 30′ R	.....
				West of lock No. 39.									
137	6.16	Moyer	Street	Whipple wooden, with wrought-iron lower chords	77.4	6	78.6	1	13.10	....	....	17° 30′ R	.....
.....	64.60	Village of Little Falls	Road	Wrought-iron riveted	87.10	7	....	1	15.8	....	....	....	.....
138	94.46	R. Castler	Farm	Whipple wooden	72.8	6	74.7	1	12.2	....	....	....	1886
139	178.39	H. Castler	Farm	Whipple wooden	72.0	6	73.8	1	12.7	....	....	....	1890
				West of lock No. 40.									
140	73.05	Snell	Farm	Whipple wooden, with wrought-iron lower chords	72.4	6	74.3	1	12.4	....	....	....	1890
141	124.83	Stawrings	Farm	Whipple wooden	71.5	6	73.8	1	12.6	....	....	....	1891
142	160.53	Steele	Farm	Whipple wooden	72.6	6	73.8	1	12.5	....	....	....	1890
143	197.36	Edick	Farm	Whipple wooden, with wrought-iron lower chords	71.9	6	73.9	1	12.0	....	....	....	.....
				West of lock No. 41.									
144	30.13	Palmer	Farm	Whipple wooden, with wrought-iron lower chords	72.4	6	74.6	1	12.5	....	....	....	.....
.....	46.75	Private	Foot	Suspension	....	....	....	....	....	....	....	....	.....

145	109.25	Fort Herkimer	Road	Wrought-iron, riveted	70.0	6	76.0	1	17.9	....	....	2° 30′ L	1886
.....	130.05	Private	Foot	Suspension	....	....	....	....	....	....	....	....	.....
146	181.16	Mohawk & Herkimer	Highway	Cast-iron arch	78.3	9	81.0	2	17.11	1	5.4	20° 0′ R	.....
.....	191.58	West Shore	Railroad	Wrought-iron lattice, pin and link	144.8	10	....	....	....	....	....	....	.....
147	223.38	Oswego street	Street	Wrought-iron, riveted	86.10	9	92.6	1	17.3	....	....	....	1891
				West of lock No. 43.									
148	31.24	Myers	Farm	Whipple wooden, with wrought-iron lower chords	77.2	6	78.10	1	12.6	....	....	....	.....
149	67.83	Gashouse	Street	Whipple wooden	71.10	6	73.7	1	12.2	....	....	....	.....
150	87.32	Agricultural works	Street	Wrought-iron arch	72.4	7	76.0	1	16.2	2	5.3	....	.....
151	108.09	Main street	Street	Cooper wrought-iron arch	71.5	4	80.7	1	17.1	2	6.8	12° 40′ L	.....
152	150.61	London	Farm	Whipple wooden, with wrought-iron	72.0	6	74.2	1	12.2	....	....	....	1888
153	186.36	East Frankfort	Highway	Wrought-iron trapezoidal, pin and link	115.11	12	120.0	2	17.7	....	....	32° 0′ L	.....
154	197.46	McGowan's	Road	Cast-iron arch	73.9	7	77.1	1	16.4	1	6.4	....	.....
				West of lock No. 44.									
155	11.46	Richardson	Road	Whipple wooden, with wrought-iron lower chords	72.2	6	74.3	1	12.7	....	....	....	1888
.....	28.87	Private	Foot	Whipple wooden	80.0	8	....	....	....	1	18.0	....	.....
156	45.75	Palmer's Grove	Road	Whipple wooden, with wrought-iron lower chords	75.2	6	76.6	1	13.0	....	....	15° 40′ L	.....
.....	60.27	Private	Foot	Whipple wooden	90.0	6	....	....	....	....	....	....	.....
157	77.29	Frankfort street	Street	Wrought-iron arch	71.10	8	83.8	1	17.9	2	5.7	....	1890
158	91.63	Litchfield street	Street	Wrought-iron, riveted	76.4	7	80.0	1	17.4	2	6.0	....	1889
				West of lock No. 45.									
158A	2.75	Main street	Street	Plate girder over Moyer creek	35.	4	37.6	2	16.2	2	12.2	....	.....
159	6.80	Madison street	Street	Cast-iron arch	72.2	7	75.3	1	15.10	2	6.2	8° 40′ R	.....
160	37.28	Davis	Farm	Whipple wooden	72.9	6	74.8	1	12.7	....	....	....	1887
161	74.55	Remington	Road	Whipple wooden, with wrought-iron lower chords	74.2	6	76.7	1	13.3	....	....	14° 0′ L	.....
162	96.28	Bridenbecker	Farm	Whipple wooden	71.9	6	73.0	1	12.2	....	....	....	1887
163	139.28	Thomas	Farm	Whipple wooden	71.00	6	73.2	1	12.6	....	....	....	.....
164	187.05	Van Buren	Farm	Whipple wooden	71.8	6	73.7	1	12.2	....	....	....	1888
165	217.83	Sterling	Farm	Whipple wooden	71.7	6	78.7	1	12.2	....	....	....	.....
166	296.73	Robinson	Farm	Whipple wooden	70.10	6	72.8	1	12.1	....	....	....	.....
167	328.08	Kensley	Farm	Whipple wooden	71.7	6	73.7	1	12.4	....	....	....	1886
168	363.90	Hudson	Farm	Whipple wooden, with wrought-iron lower chords	72.0	6	75.2	1	13.0	....	....	....	.....
169	387.06	Four-mile Grocery	Road	Whipple wooden	72.0	6	73.7	1	12.1	....	....	....	.....
.....	415.30	Private	Foot	Suspension	....	....	....	1	....	....	....	....	.....
170	442.02	Morris	Road	Whipple wooden, with wrought-iron lower chords	72.9	6	75.0	....	14.3	....	....	....	.....
.....	451.49	West Shore	Railroad	Wrought-iron lattice, pin and link	160.0	9	....	....	....	....	....	....	.....
171	466.53	Furgeson	Road	Whipple wooden	72.4	6	78.5	1	14.1	....	....	....	.....
172	495.68	Ladd	Farm	Whipple wooden	72.10	6	74.6	1	12.9	....	....	....	.....

TABLE SHOWING BRIDGES ON THE EASTERN DIVISION, ETC.—ERIE CANAL—(*Continued*).

Number.	Distance in chains.	NAME.	Class.	Character of truss.	Clear span.	Number of panels.	Span out to out of panel points.	ROADWAY.		SIDEWALK.		Skew.	When built or rebuilt*.
								Number.	Width clear.	Number.	Width.		
				Over side-cut at West Troy.									
1	......	Lower side-cut	Street	Cast-iron pipe, trapezoidal	45.4	....	....	....	....	....	....	....	.....
2	......	Upper side-cut	Street	Whipple cast-iron arch	100.0	9	....	....	....	....	....	....	.....
3	......	Lower basin swing	Tow-path	Iron plate girder	45.0	....	....	....	....	....	....	....	.....
4	......	Upper basin swing	Tow-path	Iron plate girder	60.8	....	....	....	....	....	....	....	.....
5	......	Union street	Street	Whipple wooden	48.0	....	....	....	....	....	....	....	.....
				Over Rocky Rift Feeder.									
1	......	Tow-path at entrance.*	Tow-path	Wooden stringers and plank	28.7	....	....	1	13.	....	....	....	1891
2	......	....	Road	Whipple wooden	28.2	3	31.	1	11.	....	....	....	1891
3	......	....	Farm	Whipple wooden	29.0	3	30.	1	12.	....	....	....	.....
4	......	....	Farm	Whipple wooden	28.1	3	30.	1	11.6	....	....	....	.....
5	......	....	Farm	Wooden stringers and plank	27.6	....	....	1	12.	....	....	....	.....
6	......	....	Farm	Whipple wooden	29.3	3	30.	1	12.	....	....	....	.....
7	......	....	Farm	Whipple wooden	30.2	3	31.7	1	12.	....	....	....	.....
8	......	....	Farm	Wooden stringers and plank	29.10	....	....	1	12.3	....	....	....	.....
9	......	....	Farm	Whipple wooden	28.0	....	29.	1	11.3	....	....	....	.....
10	......	....	Farm	Whipple wooden	29.10	3	31.	1	11.	....	....	....	1891
11	......	....	Farm	Whipple wooden	29.7	3	31.	1	11.	....	....	....	1891
				Over Schoharie Creek Feeder.									
1	......	....	Road	Wooden stringers and plank	22.0	....	....	....	....	....	....	....	1891
2	......	....	Road	Whipple wooden	38.0	....	....	....	....	....	....	....	.....

NOTE.—For lift-bridges the "clear span" given above is length of moveable floor, and "span out to out of panel points" is distance between centers of posts.

TABLE SHOWING BRIDGES ON EASTERN DIVISION AND THEIR LOCATION—CHAMPLAIN CANAL.

Number.	Distance in feet.	NAME.	Class.	Character of truss.	Clear span.	When built or rebuilt.
				South of lock No. 1.		
1	7,266		Change	Wrought-iron arch	122.10	1889
2	5,621		Road	Wrought-iron riveted trapezoidal	98.6	1888
2A	91	Saratoga street	Road	Whipple cast-iron arch	79.6	.....
				North of lock No. 2.		
3	1,384	State yard	Street	Wrought-iron riveted arch	70.	.....
4	1,894	Ship street	Street	Wrought-iron riveted trapezoidal	73.	1890
.....	2,406	Cedar street	Foot	Wooden Whipple	.....	.....
5	3,936	Ontario street	Street	Whipple cast-iron arch	66.	.....
.....	3,970		Truss for water-pipe	Wrought-iron riveted trapezoidal	70.	.....
				North of lock No. 3.		
6	.....	Cohoes and Waterford	Street and tow-path	Wrought-iron riveted trapezoidal { 4 spans { 1 span	142. 137.6	....
				North of lock No. 4.		
1	753		Change	Whipple wooden, with wrought-iron lower chords	50.	.....
2	2,165		Farm	Whipple wooden, with wrought-iron lower chords	57.2	.....
3	4,785	Sawmill	Road	Whipple wooden	50.6	.....
3A	5,881		Tow-path over side-cut	Whipple wooden	.....	.....
3B	.....	Fourth street	Street over side-cut	Whipple cast-iron arch	71.6	.....
3C	.....		Over weigh-lock outlet	Wooden stringers and plank	.....	.....
3D	.....		Over weigh-lock outlet	Wooden stringers and plank	.....	.....
3E	.....		Over weigh-lock outlet	Wooden stringers and plank	.....	.....
4	6,294	Broad street	Street	Wrought-iron lift	71.6	1889
5	6,669	Division street	Street	Whipple cast-iron arch	66.	1890
.....	.....	D. & H. R. R	Railroad	Wrought-iron plate girder	.....	.....
				North of lock No. 6.		
6	1,501		Road	Whipple wooden, wrought-iron lower chords	64.	.....
7	3,790		Farm	Whipple wooden	62.	1888
8	5,762		Farm	Whipple wooden, wrought-iron lower chords	58.9	.....
9	6,756		Farm	Whipple wooden, wrought-iron lower chords	58.	.....
10	7,812		Farm	Whipple wooden	55.4	.....
11	10,126		Road	Whipple wooden	58.3	.....
12	11,651		Road	Whipple wooden, wrought-iron lower chords	58.	1890
13	14,387		Farm	Whipple wooden, wrought-iron lower chords	70.	1890
				North of lock No. 7.		
14	2,028		Farm	Whipple wooden, wrought-iron lower chords	57.	1889
15	3,686		Road	Whipple wooden	58.6	1888

TABLE SHOWING BRIDGES ON THE EASTERN DIVISION — CHAMPLAIN CANAL — (*Continued*).

Number.	Distance in feet.	NAME.	Class.	Character of truss.	Clear span.	When built or rebuilt.
				North of lock No. 7 — (Concluded).	′ ″	
16	7,015	....	Farm	Whipple wooden	66.3	......
17	7,656	....	Road	Whipple wooden, wrought-iron lower chords........	51.7	......
18	10,449	....	Road	Whipple wooden, wrought-iron lower chords........	59.3	1888
19	11,501	Cemetery........	Street	Whipple wooden	51.3	......
.....	12,310	D. & H. R R........	Railroad........	Wrought-iron riveted trapezoidal........	......	......
20	12,941	Railroad street........	Street	Wrought-iron riveted lift, center to center of posts........	68	1887
21	14,371	....	Street	Whipple wooden	50 2	......
22	14,922	....	Road	Whipple wooden, wrought-iron lower chords........	54.8	1890
.....	16,226	Fitchburg railroad	Railroad........	Wrought-iron riveted lift, center to center of posts........	78.9	1887
23	16,935	....	Farm........	Whipple wooden	60	......
23A	......	....	Road over waste-weir discharge	Wooden stringers and plank	......	......
24	19,360	....	Farm........	Whipple wooden, wrought-iron lower chords........	58.10	1889
.....	20,734	Fitchburg railroad........	Railroad........	Wrought-iron pin and link trapezoidal........	......	......
25	21,602	....	Farm........	Whipple wooden	66.5	1889
				North of lock No. 9.		
26	1,652	....	Farm	Whipple wooden, wrought-iron lower chords........	50.2	1889
27	2,751	....	Road	Whipple wooden, wrought-iron lower chords........	54.8	1890
28	4,020	....	Road	Whipple wooden	61.5	......
29	5,179	....	Farm........	Whipple wooden	57.10	......
30	5,914	....	Road	Whipple wooden	65.10	......
31	7,408	....	Road	Whipple wooden, wrought-iron lower chords	50.7	1888
.....	10,011	....	Foot	Whipple wooden	......	......
32	10,342	....	Road	Whipple wooden	55.0	......
33	17,015	....	Road	Whipple wooden	60.9	......
34	18,308	....	Farm	Whipple wooden, wrought-iron lower chords........	59.6	1890
35	20,258	....	Farm	Whipple wooden, wrought-iron lower chords........	61.0	1890
36	21,423	....	Farm	Whipple wooden	62.3	1889
37	22,383	....	Road	Wrought-iron arch........	70.6	......
38	24,562	....	Road	Whipple wooden, wrought-iron lower chords........	69.3	......
39	26,133	....	Farm	Whipple wooden	53.6	......
40	27,562	....	Farm........	Whipple wooden	58.1	......
41	30,865	....	Farm	Whipple wooden, wrought-iron lower chords........	50.6	......
42	32,756	....	Farm	Whipple wooden, wrought-iron lower chords........	62.9	......
43	33,735	....	Farm	Whipple wooden	61.10	1888
43A	.....	....	Road and tow-path over waste-weir	Whipple wooden	......	......
44	34,950	Wilbur's basin........	Road	Whipple wooden, wrought-iron lower chords........	57.9	1888
45	36,834	....	Farm	Whipple wooden	61.11	1889

46	38,584		Farm	Whipple wooden	56.0	.....
47	38,718		Farm	Whipple wooden	60.10	1888
48	42,735		Road	Whipple wooden, wrought-iron lower chords	58.11	1888
49	43,871		Farm	Whipple wooden	62.5	.....
50	46,211		Farm	Whipple wooden	64.2	1889
51	47,738	Salisbury's	Road	Whipple wooden	64 0	.....
52	51,913		Farm	Whipple wooden	55.5	1888
53	54,491		Farm	Whipple wooden	48.8	1890
.....	56,513	Costello's	Foot	Whipple wooden	.....	.....
54	57,675		Farm	Whipple wooden	64.2	.....
.....	58,622	Broder's	Foot	Whipple wooden	.....	.....
55	59,701		Farm	Whipple wooden	50.8	1890
56	60,883		Farm	Whipple wooden	69.2	.....
57	65,538		Farm	Whipple wooden, wrought-iron lower chords	54.4	1889
58	67,009		Farm	Whipple wooden	52.2	1890
59	70,854		Farm	Whipple wooden, wrought-iron lower chords	50.0	.....
60	74,694		Farm	Whipple wooden	65.0	.....
61	75,732	Ferry	Street	Whipple cast-iron arch	71.5	.....
62	76,598	Saratoga	Street	Wrought-iron arch	84.2	.....
63	81,484		Farm	Whipple wooden	74.11	.....
63A	.....		Tow-path over old canal	Whipple wooden	.....	.....
64	83,710		Farm	Whipple wooden, wrought-iron lower chords	63.6	.....
65	84,751		Change	Whipple wooden	65.10	.....
				North of lock No. 10.		
.....	.....	Northumberland	Road and tow-path over Hudson river	Whipple wooden	.....	.....
66	3,298	Thompson's mill	Road	Whipple wooden, wrought-iron lower chords	72.9	.....
				North of lock No. 11.		
67	2,560		Farm	Whipple wooden	66.0	.....
68	4,898		Farm	Whipple wooden	57.6	.....
69	6,378		Farm	Whipple wooden	62.9	.....
				North of lock No. 12.		
70	809		Road	Whipple wooden	59.	.....
71	1,648		Road	Whipple wooden, wrought-iron lower chords	56.6	1890
72	3,691	Fort Miller	Change	Whipple wooden	56.	1890
73	4,676			Abandoned	.....	.....
74	5,479		Road	Whipple wooden	54.2	.....
				North of lock No. 13.		
75	912		Road and change	Wrought-iron arch	58.0	.....
76	3,223		Farm	Whipple wooden	50.10	.....
77	4,969		Farm	Whipple wooden	56.4	.....
78	6,792		Road	Whipple wooden, wrought-iron lower chords	56.0	1890
79	8,557		Farm	Whipple wooden	55.2	1890
80	9,597		Farm	Abandoned	48.0	1889
81	10,351		Road	Whipple wooden	56.0	.....
82	12,502		Road	Whipple wooden	60.0	.....
.....	12,811	Moses Kill	Foot	Whipple wooden	.....	.....

TABLE SHOWING BRIDGES ON THE EASTERN DIVISION — CHAMPLAIN CANAL — (*Concluded*).

Number.	Distance in feet.	NAME.	Class.	Character of truss.	Clear span.	When built or rebuilt.
				North of lock No. 14.		
83	957	....	Road	Whipple wooden, wrought-iron lower chords	70.0	....
84	2,364	....	Road	Whipple wooden	62.3	....
85	5,457	....	Road	Whipple wooden	59.6	....
86	6,454	....	Road	Whipple wooden	56.1	....
....	7,204	Satterlee's	Foot	Whipple wooden	....	....
87	8,178	....	Farm	Whipple wooden	61.9	....
88	11,042	....	Road	Whipple wooden, wrought-iron lower chords	68.0	....
89	11,996	....	Road	Whipple wooden	62.0	....
90	12,494	....	Road	Whipple wooden	55.8	....
91	13,715	....	Farm	Whipple wooden	58.1	....
92	15,179	....	Farm	Whipple wooden	57.0	....
93	16,095	....	Farm	Whipple wooden	50.0	....
94	17,503	....	Farm	Whipple wooden	56.2	....
95	18,784	....	Farm	Whipple wooden	55.2	....
96	24,122	....	Road	Whipple wooden, wrought-iron lower chords	80.4	....
97	25,917	....	Road and change	Wrought-iron, pin and arch	78.7	....
98	27,370	Notre Dame	Street	Wrought-iron, pin and arch	79.7	....
....	27,903	D & H. R. R	Railroad	Wrought-iron riveted trapezoidal	....	....
99	28,631	East street	Street	Whipple cast-iron arch	59.5	....
....	29,130	D. & H. R. R	Railroad	Wrought-iron plate girder	....	....
99A	....	Main street	Street over old feeder	Whipple wooden	38.9	....
....	....	Mechanic street	Street over old feeder	Wrought-iron Cooper truss	....	....
				North of lock No. 15.		
100	1,417	....	Road	Whipple wooden	76.8	....
....	2,427	....	Foot	Suspension	80.0	....
101	10,655	....	Road and change	Wrought-iron arch	79.8	....
102	12,935	....	Farm	Whipple wooden	50.9	....
103	16,6 7	Dunham's	Road	Whipple wooden, wrought-iron lower chords	57.4	....
104	33,153	....	Road	Whipple wooden, wrought-iron lower chords	52.1	1889
105	34,281	....	Farm	Whipple wooden, wrought-iron lower chords	52.0	1890
106	40,867	Smith's basin	Road	Whipple wooden, wrought-iron lower chords	57.6	....
107	43,118	....	Road	Whipple wooden	56.0	....
108	45,870	....	Farm	Whipple wooden	63.0	1890
109	47,271	....	Farm	Whipple wooden	57.10	....
110	48,308	....	Farm	Whipple wooden	57.3	....
111	50,995	....	Road	Whipple wooden	52.4	1888
112	53,179	....	Road	Whipple wooden	52.4	1890
113	55,810	....	Farm	Whipple wooden, wrought-iron lower chords	56.2	....
114	58,146	....	Farm	Whipple wooden	56.8	....

115	59,048		Farm	Whipple wooden, wrought-iron lower chords	62.0	1888
.....	61,495		Foot	Suspension	78.0	....
				North of lock No. 17.		
116	173	Ann street	Street	Wrought-iron riveted trapezoidal	78.6	....
				North of lock No. 18.		
.....	322	D. & H. R. R.	Railroad	Wrought-iron riveted trapezoidal	....	....
117	666		Change	Whipple wooden, wrought-iron lower chords	66.4	....
118	1,558		Farm	Whipple wooden, wrought-iron lower chords	61.6	....
119	8,295		Farm	Whipple wooden	58.6	....
.....	13,405	Dewey's	Road	Wrought-iron pin and link trapezoidal	....	....
				North of lock No. 19.		
120	1,712		Tow-path	Whipple wooden	84.	....
121	4,635		Road	Wrought-iron arch	72.10	....
.....	9,356	Comstock's	Road	Wrought-iron riveted trapezoidal	69.0	....
122	13,825		Farm	Whipple wooden	72.0	....
				North of lock No. 20.		
123	56		Change	Whipple wooden	57.3	....
124	765		Road	Whipple wooden	62.3	....
125	1,953		Farm	Whipple wooden	64.3	....
.....	2,305	D. & H. R. R	Railroad	Wrought-iron riveted trapezoidal	132.0	....
126	3,582		Farm	Whipple wooden, wrought-iron lower chords	56.3	1889
127	4,750		Farm	Whipple wooden	63.6	....
128	7,790		Road	Wrought-iron arch	67.7	....
129	10,463		Farm	Whipple wooden	67.6	1888
130	11,171		Farm	Whipple wooden, wrought-iron lower chords	66.9	....
131	14,077		Farm	Whipple wooden	62.0	1889
132	15,215		Farm	Whipple wooden	62.7	....
133	17,582		Farm	Whipple wooden	57.9	....
133	18,615			Abandoned	....	....
134	22,035		Farm	Whipple wooden	63.0	....
.....	23,118	D. & H. R. R	Railroad	Wrought-iron riveted trapezoidal	96.6	....
136	23,885			Abandoned	....	....
.....	25,753	D. H. & R. R.	Railroad	Wrought-iron riveted trapezoidal	90.9	....
137	26,295	Boardman's	Road	Whipple wooden, wrought-iron lower chords	68.4	....
137A	27,700		Change	Whipple wooden, wrought-iron lower chords	102.4	....
138	28,522		Street	Wrought-iron arch	82.3	....
139	28,912		Foot	Wrought-iron riveted trapezoidal	57.9	....
				Over lock No. 23.		
140	......		Street	Wrought-iron arch	93.0	....

NOTE.— Of the above bridges only those bearing numbers are owned and maintained by the State of New York.

The foregoing bridges are classified as follows:

First. As to use:

Bridges owned and maintained by the State.

KIND OF BRIDGES.	Over Erie canal.	Over West Troy side-cuts.	Over Schoharie creek feeder.	Over rocky rift feeder.	Over Champlain canal, including side-cuts.	Over Glens Falls feeder.	Totals.
1. Highway or street	85	3	2	1	62	7	160
2. Highway and change	4	....	....	....	5	1	10
3. Farm	77	....	....	9	68	8	157
4. Foot	3	....	....	....	1	....	4
5. Lift	3	....	....	....	2	....	5
6. Swing	1	2	....	....	....	....	3
7. Change	1	....	....	....	6	1	8
8. Tow-path over feeders, etc	1	....	....	1	3	....	5
9. Over discharge from waste-weirs	1	....	....	....	5	....	6
Totals	176	5	2	11	152	12	358

Bridges not owned nor maintained by the State.

1. Highway or street	4	....	....	....	3	....	7
2. Highway and change	....	....	....	....	1	....	1
3. Farm	1	....	....	....	....	1	2
4. Foot	10	....	....	....	8	1	19
5. Railroad (lift)	....	....	....	....	1	....	1
6 Railroad (fixed)	12	....	....	....	9	2	23
7. Swing	1	...	....	....	....	....	1
8. Truss carrying water pipe	1	....	....	....	1	....	2
Totals	29	....	....	....	23	4	56

Second. As to style and material of trusses:

Bridges owned and maintained by the State.

CHARACTER OF TRUSS.	Over Erie canal.	Over West Troy side-cuts.	Over Schoharie creek feeder.	Over rocky rift feeder.	Over Champlain canal, including side-cuts.	Over Glens Falls feeder.	Totals.
1. Whipple wooden	55	1	1	8	80	8	153
2. Wooden stringers and plank	....	....	1	3	4	....	8
3. Whipple wooden, with wrought-iron lower chords	61	....	....	....	43	3	107
4. Wooden latticed (covered)	1	....	....	....	....	....	1
5. Suspension (foot)	2	....	....	....	....	....	2
6. Whipple cast-iron trapezoidal	3	1	....	....	....	....	4
7. Whipple cast-iron arch	21	1	....	....	6	....	28
8. Cast-iron pipe arch	3	....	....	....	....	....	3
9. Wrought-iron arch	7	....	....	....	12	1	20
10. Wrought-iron pin and link trapezoidal	6	....	....	....	....	....	6
11. Wrought-iron riveted trapezoidal	12	....	....	....	5	....	17
12. Wrought-iron riveted trapezoidal (lift)	3	....	....	....	2	....	5
13. Wrought-iron riveted trapezoidal (swing)	1	...	....	....	....	....	1
14 Wrought-iron plate girder (swing)	....	2	....	....	....	....	2
15 Wrought-iron plate girder (fixed)	1	....	....	....	....	....	1
Totals	176	5	2	11	152	12	358

Bridges not owned nor maintained by the State.

CHARACTER OF TRUSS.	Over Erie canal.	Over West Troy side-cuts.	Over Schoharie creek feeder	Over rocky rift feeder.	Over Champlain canal, including side-cuts.	Over Glens Falls feeder.	Totals.
1. Wooden whipple	3	....	....	...	7	2	12
2. Wooden latticed (covered)	1	....	....	....	....	....	1
3. Wooden draw bridge	1	....	....	....	...	....	1
4 Suspension (foot)	8	....	....	....	2	....	10
5. Whipple cast-iron arch	1	....	....	....	....	....	1
6. Wrought-iron arch	1	....	....	....	....	....	1
7. Wrought-iron pin and link trapezoidal	4	....	....	....	2	....	6
8. Wrought-iron riveted trapezoidal	1	....	....	.	4	....	5
9. Wrought-iron riveted swing	1	....	....	....	....	....	1
10. Wooden Howe truss, railroad	....	....	....	....	....	1	1
11. Wrought-iron pin and link trapezoidal, railroad.	....	....	....	....	1	....	1
12. Wrought-iron riveted trapezoidal, railroad	8	....	....	....	4	1	13
13. Wrought-iron plate girder, railroad	....	....	....	....	2	....	2
14. Wrought-iron riveted trapezoidal railroad lift	....	....	....	....	1	....	1
Totals	29	....	....	....	23	4	56

APPENDIX C.

REPORT

OF THE

DIVISION ENGINEER

OF THE

MIDDLE DIVISION

FOR THE

YEAR ENDING SEPTEMBER 30, 1891.

APPENDIX C.

Syracuse, N. Y., *October* 1, 1891.

Hon. John Bogart, *State Engineer and Surveyor:*

I have the honor to submit the annual report of the middle division for the fiscal year ending September 30, 1891:

	Miles.	Totals.
This division comprises that portion of the Erie canal lying between the east lines of Oneida county and the south lines of Wayne county	97.02	
Also the following unabandoned lateral canals:		
Oswego canal, from Syracuse to Oswego	37.78	
North and south side-cuts and slips at Salina	2.02	
Slips at Liverpool, Oswego canal	0.25	
Baldwinsville side-cut	0.59	
Cayuga and Seneca canal, Montezuma to Cayuga and Seneca lakes	22.99	
Black River canal, Rome to Lyons Falls	35.52	
Old Oneida Lake canal, Higginsville to first lock	1.05	
Chenango canal from Erie canal to Fayette street,	0.05	
Chemung canal, lake level	2.53	
		199.80
River Improvements.		
Black river, Lyons to Carthage	42.50	
Onondaga outlet, Onondaga lake to Seneca river	0.75	
Oneida river, Three River Point to Brewerton and Oneida lake	20.00	
Seneca river towing-path, Mud lock to Baldwinsville	5.83	
Seneca river, Baldwinsville to Jack's Reefs (not used)	11.75	
Ithaca inlet, Cayuga lake to Ithaca	2.05	
Seneca lake outlet, from Cayuga and Seneca canal to Seneca lake	0.17	
		83.05

NAVIGABLE FEEDERS.

	Miles.	Totals.
Limestone creek feeder, Erie canal to Fayetteville,	0.83	
Butternut creek feeder, Erie canal to feeder dam above Dunlap's mills	1.67	
Camillus feeder, Erie canal to Camillus	1.04	
Delta feeder, foot of lock No. 9, Black River canal to Delta	1.40	
Black river feeder, Boonville to head of pond at Forestport	11.29	
		16.23
Total		299.08

ARTIFICIAL FEEDERS — NOT NAVIGABLE.

	Miles
Chenango canal, summit level	5.31
Leland pond feeder	0.31
Madison brook feeder	2.99
West branch feeder	5.83
Bradley's brook feeder	0.67
Hatch's lake feeder	0.23
Kingsley brook feeder	1.87
Oriskany creek feeder	0.53
Mohawk feeder at Rome	0.03
Oneida creek feeder	2.91
Cowassalon creek feeder	0.40
Chittenango creek feeder	0.28
Cazenovia lake outlet (improved)	0.51
Tioughnioga river feeder	1.00
De Ruyter reservoir outlet	0.12
Orville feeder (unnavigable portion)	0.55
Camillus feeder (unnavigable portion)	0.65
Carpenter brook feeder	0.18
Skaneateles creek feeder	0.09
Putnam brook feeder	0.20
Centerport feeder	0.18
Owasco creek feeder (including 859 feet of iron pipe)	2.10
Lansingkill feeder	1.80

	Miles.
Sugar river feeder	0.14
New outlet of third Bisby lake	0.06
New outlet of Canachagala lake	0.16
Total	29.10

SOURCES OF WATER SUPPLY.

The canals upon this division are supplied with water from the following-named sources:

Erie Canal — Frankfort and Rome levels.

(Three and three hundred and fifty-six thousandths miles of Frankfort level on middle division. The Rome level, lock No. 46 to lock No. 47 55.957 miles.)

	Cubic feet per minute
Leland's pond, Madison brook reservoir, Eaton brook reservoir, Bradley brook reservoir, Hatch's lake, Kingsley brook reservoir and Oriskany creek, feed through the Chenango canal, Oriskany creek and Oriskany creek feeder into the Rome level, six miles west of lock No. 46	6,000
Mohawk river, Black river, Forestport pond, White lake reservoir, Chub lake, Sand lake, first, second and third Bisby lakes, Woodhull reservoir, Twin lakes, South branch reservoir, North branch reservoir and Canachagala lake, feed through the Rome feeder and Black River canal into the Rome level at Rome, fourteen miles west of lock No. 46	13,000
Oneida creek enters canal through feeder, thirty miles west of lock No. 46	1,000
Cowassalon creek enters canal through feeder, thirty-one and a half miles west of lock No. 46	200
Cazenovia lake reservoir (for 100 days), Erieville reservoir (for 100 days), and Chittenango creek enter canal through Chittenango creek feeder, forty-one and a half miles west of lock No. 46	5,641

	Cubic feet per minute.
DeRuyter reservoir (for 100 days), enters canal through Limestone creek (Fayetteville) feeder, fifty miles west of lock No. 46	3,891
Limestone creek (natural flow) enters canal through Limestone creek (Fayetteville) feeder, fifty miles west of lock No. 46	500
Jamesville reservoir (for sixty days) enters canal through Orville feeder, fifty-two miles west of lock No. 46	2,000
Butternut creek (natural flow) enters canal through Orville feeder, fifty-two miles west of lock No. 46	500
Total	32,732

Short level, from lock No. 47 to No. 48 = .188 of a mile; fed from Rome level.

Mile level, from lock No. 48 to 49 = .714 of a mile; fed from Rome level through short level.

Syracuse level, from lock No. 49 to 50 = 5.014 miles; fed from Rome and Jordan levels.

Jordan level, from lock No. 50 to 51 = 14.903 miles.

Otisco lake reservoir feeds through Camillus feeder into the canal four miles west of lock No. 50	5,146
Nine-mile creek (natural flow), fed through Camillus feeder into canal, four miles west of lock No. 50	800
Carpenter brook enters canal through feeder, ten miles west of lock No. 50	200
Skaneateles lake reservoir feeds into canal at Jordan, thirteen miles west of lock No. 50	8,766
Total	14,912

Port Byron level, from lock No. 51 to 52 = 7.793 miles; from Jordan level, through lock No. 51.

Putnam brook feeder, at Weedsport	200
Owasco lake reservoir, through feeder at Port Byron	4,033
Total	4,233

	Cubic feet per minute.
Montezuma level, from lock No. 52 to Wayne county = 9.098 miles; from Port Byron level, through lock No. 52 and from Lake Erie	4,000

Oswego Canal.

Erie canal at Syracuse	10,000
Seneca river	54,000
Oneida river	20,000
Total	84,000

Cayuga and Seneca Canal.

Seneca lake	18,000
Erie canal at Montezuma	4,000
Total	22,000

SUMMARY OF WATER SUPPLY MEASURED.

Erie Canal.

	Cubic feet per minute.	
	Amounts.	Totals.
Frankfort and Rome levels	32,732	
Jordan level	14,912	
Port Byron level	4,233	
		51,877
Oswego Canal.		
From Seneca river	54,000	
From Oneida river	20,000	
		74,000
Cayuga and Seneca Canal.		
From Seneca lake	18,000	
		18,000
		143,877

NOTE.— This does not include water used more than once.

BLACK RIVER CANAL AND RIVER IMPROVEMENT.

CANAL.	Elevation in feet above tide-water.	Surface area in acres.	Average area in acres.	Average depth in feet.	Capacity in cubic feet.
White Lake reservoir	......	....	296	5	64,468,800
Chub Lake reservoir (approximate)	1,599	....	200	4	34,848,000
Sand Lake reservoir	....	....	306	15	199,940,400
Woodhull reservoir (two years in filling)	1,854	1,236	1,118	18	876,601,440
First, Second and Third Bisby lakes (approximate)	....	....	....	3⅛	40,000,000
Canachagala lake (approximate)	....	....	320	4	55,756,800
North Lake reservoir (can fill twice yearly)	1,821	423	277	28	337,851,360
South Lake reservoir	2,019	518	372	26	421,812,820
Twin Lakes reservoir (approximate)	....	....	175	8	60,984,000
Forestport pond	....	....	....	....	....
Mohawk river, through Delta feeder	....	....	....	....	....
Pond above Lyon's Fall dam	....	....	....	....	....
River Improvements.					
Forge pond	....	....	....	....	....
First lake of the Fulton chain	1,691	....	....	....	....
Second lake of the Fulton chain	1,691	....	....	....	....
Third lake of the Fulton chain	1,691	....	....	....	....
Fourth lake of the Fulton chain	1,691	....	....	....	....
Fifth lake of the Fulton chain	1,691	9	....	....	....
Sixth lake of the Fulton chain	1,772	109	....	....	....
Seventh lake of the Fulton chain	1,772	867	....	....	....
Eighth lake of the Fulton chain	1,776	309	....	....	....
Black river	....	....	....	....	....
Moose river	....	....	....	....	....
Beaver River reservoir	....	....	....	....	....

There has been no change in the water supply during the fiscal year.

NAVIGATION.

All the canals of this division were closed November 30, 1890, and opened May 5, 1891. Water was scarce which made the filling slow, but as light boats could move and there were few loaded ones, the real delay was not serious.

The following disasters occurred during the year:

October 28, 1890, one of the cables broke on John street lift-bridge, Utica, letting down a counter-weight box and breaking about fifteen feet of flooring. No person or private property was injured. The delay to street travel was six hours, to navigation none.

October 31, 1890, a second accident happened at John street lift-bridge. After the breaking of the seven-eighth inch cable on the twenty-eighth it was decided to replace all the cables with one inch. The old grips were planed out to fit the new cables, but were made too large so they failed to grip firmly, consequently the cables gradually slipped and let down the panels of the moveable floor in succession. The needle-beams were not injured, but the rest of the moveable floor was practically destroyed. Navigation was delayed forty-two hours.

December 6, 1890, the Amos mill at Syracuse, which draws water over a spillway on the berme side of the canal, shut down without notifying the superintendent, consequently no provision was made to take care of the water and the level was flooded, running over the banks between West and Geddes streets. The facts were discovered and the water stopped in time to prevent serious injury to the banks.

May 15, 1891, while the change-bridge above lock No. 6, on the Cayuga and Seneca canal was in process of erection, it fell into the canal, injuring the bridge somewhat and delaying the work, but causing no other damage or delay. The accident was caused by attempting to erect a new iron bridge, using the old bridge as false work, with no precaution to support or strengthen it.

June 28, 1891, a private bridge at Millen's cement works, near Warners, fell under very similar circumstances as the above. One man was killed.

July 20, 1891, a leak started at the west end of Crane brook aqueduct. On clearing the pit of water it was found that holes had worked through under the west abutment, between the foundation timbers. The water had probably been a long time gradually cutting its way through, and when it finally broke through the puddle in rear of the abutment, it formed a current which could not be stopped by the usual expedients adopted to prevent drawing the water from the prism. There was no breach through the banks and consequently no damage except to the bottom of the prism, and perhaps a slight additional undermining of the foundation, which had settled bodily about two inches, not breaking the masonry. The surface of Crane brook, even at low water, stands a trifle above the bottom of the floor stringers of the aqueduct, consequently it was necessary to build coffer-dams in the brook, above and below the structure, as well as in the canal east of the same, and pump out to the foundation. This made the repair a long, tedious matter, though the actual repair of the break was quickly done after the water was removed. The water in the pit, which had formed in the rear of the abutment could not all be pumped out, there being about three feet in depth when the pumps were dry. Concrete mixed very dry and put in bags was carefully placed and rammed solid. The first being so disposed as to stop the holes through the foundation, with a second, and in some places, a third course above them. The space above the concrete was then thoroughly puddled with clay and gravel to canal bottom. Loose stone was also rammed back between the foundation timbers from the front of the wall. The detention was nine days, part of which was caused by the fact that about the same time a serious break occurred at Flat Stone creek aqueduct, on the eastern division, which would require a much longer time to repair. Consequently it was deemed inadvisable to push the work at night, when the work could not be as well performed as by daylight.

August 10, 1891, a break was reported at Butternut aqueduct, but on examination it was found to be a trifling matter and was easily remedied. The original floor timbers appear to have been deeper than those now used, so that a hole was left on top of the floor timber, and between it and the masonry, at the west berme corner. The filling with which this hole had been stopped — probably poor concrete — had gradually worked out. A stream about six by ten inches flowed through the hole under a seven-foot head. There was no damage except the mere loss of water, which was soon stopped by replugging the hole. It should be thoroughly repaired.

No other disasters of note have occurred or any detention to navigation than as above noted.

WATER SUPPLY.

This season having been, especially in the early part, rather dry, great care has been necessary to husband the water, and at times there has been barely sufficient to keep boats moving, though I have heard of no actual detention occurring. This fact gives additional force to the remarks in previous reports on the necessity for additional sources of supply and additional storage reservoirs.

A further argument is found in the discovery of a partial failure of the pipes in De Ruyter reservoir, which rendered it necessary to draw the water from it toward the close of the season. Had this been discovered earlier it would have seriously reduced the available supply, and may still do so if the usual fall rains should be light, and, consequently, other reservoirs run low. The same condition is to be expected at other reservoirs, notably at Eaton, where the gates show signs of failing, and at Kingsley brook, where the bridge abutments which form the support to the bulkhead must soon be replaced, which will require the drawing of about half the water.

The failure to appropriate the necessary funds to complete the Forestport dam and reservoir but emphasizes these remarks. Even if the appropriation is made in the coming winter there will be a delay of more than a year, as in addition to the time lost by the forced abandonment of the work and consequent closing of the contract, a considerable delay must attend the reletting of the work. As the case now stands everything at the Forestport dam is practically completed, except the part which holds back the water. The money so far expended is a total loss until the dam is completed. An additional appropriation should be made to complete the dam and also to clear the reservoir and build the roads crossing it, the present appropriation for the latter having proved insufficient to induce contractors to even bid for the clearing alone.

The completion of this reservoir, the improvement of the Port Byron feeder and the enlargement of the fedder leading from Kingsley brook reservoir, as recommended in the reports of the two previous years, is earnestly urged.

I also renew the previous recommendations to raise the Bradley brook reservoir dam and build new spillway and overfalls; to repair and rearrange valves, etc., at Eaton reservoir; to extend the pipes and rebuild the bridge abutments and bulkhead at Kingsley brook reservoir; to protect the foot of Jamesville dam and make new channel for waste water; and to enlarge valves in guard-locks on the Oswego canal. I refer to report of last year for particulars.

The necessity for raising the spillways at the Amos and Haskins mills is confirmed by the fact noted under the head of disasters, which shows conclusively that special feeding to supply the mills is regularly practiced and becomes dangerous when the mills are stopped without notice. This special feeding is now required to keep the water at standard height and can only be stopped by so constructing these spillways that they can take only the real surplus.

I renew my former recommendations to raise them to seven feet above canal bottom.

MACHINERY FOR HAULING BOATS INTO LOCKS.

The utility of this device having been thoroughly established, I advise that it be placed on all locks having only the standard depth of water on miter-sills and standard width of chamber, except in cases of locks to be built or lengthened. A year should be allowed in such cases for thorough settlement of the fresh embankments.

IMPROVEMENT OF CHANNEL.

Some bottoming out was done in the spring on the Erie canal, mainly on the tow-path side. On the other canals only ordinary cleaning out was done so their condition remains as before if not worse.

On these canals it is urgent that this improvement should be made, as well as the raising and strengthening of low and weak banks and the protection of the Black River canal from extensive deposits of shale which accompany every heavy rain and seriously interfere with navigation. As stated in former reports, I believe these deposits can best be controlled by receiver dams of loose stone and brush which need be only made sufficiently tight to stop the debris. These receivers can be cleaned out at convenience, and in many cases the material used to advantage on the tow-path and adjacent roads. A special appropriation should be made for this purpose.

On the Erie canal no thorough improvement of the prism can be made without removing the old wall benches and substituting full depth slope wall. This is especially the case on the Jordan level where the natural material is generally a soft marl which gives no support to the foot of the wall. In the original construction an attempt was made to remedy the difficulty by removing the marl under and in front of the wall and replacing it (to form the bench) with gravel and clay, but experience shows this to be ineffectual. In constructing the full depth slope wall, a system of sheet piling, with liberal use of brush and stone at bad sloughing places has proved effective. There are about ten miles of this old bench wall on the Rome, Syracuse and Jordan levels.

On the Oswego canal the bottom has become filled to a depth of from six inches to a foot, on nearly all the "canal" levels, rendering it necessary to carry the water above standard height.

This reduces clearance under bridges and relative height of banks, which increases the danger of collision of light boats with the bridges, and flooding the banks, both by swells from steamers and excessive feeding. The canal is navigated quite extensively by fast pleasure yachts passing to and from Lake Ontario, as well as by numerous excursion boats, so the danger from swells is greater, aside from the condition of the prism, than on other canals, making the improvement more imperative. A special appropriation should be made for this purpose.

A further and, in my opinion, very desirable improvement to the channel could be made by deepening the canal one foot by taking out the bottom at all points where it would not interfere with structures, leaving a bench at the foot of slope walls to protect them from undermining. This could be done at small cost considering the benefits obtained. The additional foot of waterway under the boats would facilitate towing and consequently increase the speed with the expenditure of the same force.

STRUCTURES.

On the Erie canal and its feeders, all the aqueducts need pointing and seven need extensive repairs. Fifteen bridges and ten bulkheads or waste-weirs need rebuilding. Sixteen culverts need rebuilding or extensive repairs. The other structures are generally in good condition.

On the Oswego canal and its side-cuts, two bridges, two bulkheads, half of one culvert and two dams should be rebuilt. A few other structures need extensive repairs. The rest are generally in good condition.

On the Cayuga and Seneca canal the structures are generally good, though a few bridges and dams need quite extensive repairs.

On the Black River canal two aqueducts need new trunks and one needs a new masonry pier. A few small bridges should be rebuilt on the main line and feeders. The wooden swing and fixed bridges on the river improvement should be rebuilt with iron. Twenty-two locks should be rebuilt and fifteen need extensive repairs. Other structures are in fair condition. The neglect last winter to appropriate money to improve this canal has increased the liability of failure in some of these locks by adding another year's decay to the already weakened walls. Some repairs to foundations have been made with the fund for maintenance and operation, but the amount allotted to the Black River canal is barely adequate for the operating expenses and ordinary repairs. The extensive repairs necessary to preserve the canal must be specially provided for.

The former rate of rebuilding locks did not even approximately keep pace with the decay, and the money is therefore wasted, unless the number rebuilt each winter is largely increased. I made a careful inspection of this canal in August, 1890, and found, out of 109 locks, twelve should be rebuilt at once, as they could hardly run through that season; eight should be rebuilt soon, but would probably run through another season. In forty-five locks the alignment was fair to good, and the stone bad to fair, and several others had bad foundations, though the alignment and stone were good. The foundations of the others were presumably good, though I could not examine them while the water was in the canal.

The condition is rapidly growing worse, and unless a liberal appropriation is made, this canal must be closed except as a feeder, and probably would not last many years as a feeder without extensive repairs. The life of the Erie canal depends on keeping the Black River canal in first-class condition as a feeder, which, I believe, is only possible by keeping it open as a navigable canal. It seems folly to spend large sums in improving the Erie canal and building reservoirs on the Black river waters, unless the conduit which carries those waters to the Erie is preserved. It is true only a short section of the Black River canal is necessary to convey this water to the Mohawk or its tributaries, and through them to the Erie canal at Rome; but the losses from various causes would be much greater, and no reduction of the feed-water can be permitted without detriment to the Erie canal. Feeding through the canal also relieves the Rome feeder which is insufficient to furnish the full supply, the surplus above its capacity being wasted over the dam. Its capacity could be increased by raising the dam, but this would involve heavy damages to property lying along the river. The traffic over the Black River canal is considerable. The production and transportation of the material for this traffic furnishes a livelihood to a large number of people and the employment of a large amount of capital, which would be practically destroyed by its abandonment as a navigable canal, even if preserved as a feeder.

I append a table showing the general condition of the locks on this canal corrected to date of this report:

TABULAR STATEMENT OF THE CONDITION OF LOCKS ON THE BLACK RIVER CANAL AND BLACK RIVER IMPROVEMENT.

NOTE.—In grading the quality of the stone, I have borne in mind the general condition of the Black River canal only. The stone south of Boonville (lock No. 71), would with few exceptions, be properly classed as poor or bad, and are only fit for backing.

Those marked * will probably not last another season; those § will probably last one or two years.

Number.	REMARKS.	GENERAL CONDITION.	
		Alignment.	Stone (quality).
1	Rebuilt 1890-91	Good.	Good.
2	Bad foundation	Good.	Good.
*3	Rebuild soon	Fair.	Good.
4		Good.	Good.
5		Good.	Good.
6		Good.	Good.
§7	Rebuild soon	Bad.	Bad.
8	Rebuilt in 1887-88	Good.	Good.

Number.	REMARKS.	GENERAL CONDITION.	
		Alignment.	Stone (quality).
9	Bad foundation	Good.	Bad.
10		Good.	Bad.
11		Fair.	Bad.
12	Rebuilt in 1889-90	Good.	Good.
*13	Rebuild at once	Very bad.	Bad.
14	Bad foundation	Good.	Bad.
15		Fair.	Bad.
16		Fair.	Poor.
17	Bad foundation	Good.	Poor.
*18	Rebuild at once	Bad.	Bad.
19		Good.	Poor.
20	Bad foundation	Good.	Very bad.
21	Bad foundation	Good.	Bad.
22	Bad foundation	Good.	Bad.
23	Poor foundation	Fair.	Bad.
24	Bad foundation	Fair.	Fair.
25	Bad foundation	Good.	Bad.
26	Bad foundation	Good.	Very bad.
27	Bad foundation	Fair.	Poor.
§28	Rebuild soon	Fair.	Bad.
29		Good.	Fair.
30	Poor foundation	Good.	Fair.
31		Good.	Fair.
§32	Rebuild soon	Fair.	Very bad.
*33	Rebuild at once	Bad.	Very bad.
§34	Rebuild soon	Poor.	Very bad.
§35	Rebuild soon	Poor.	Very bad.
36		Fair.	Bad.
*37	Rebuild at once	Bad.	Very bad.
38		Fair.	Fair.
*39	Rebuild at once	Fair.	Very bad.
*40	Rebuild at once; 40, 41, 42 and 43, combined	Bad.	Very bad.
41		Good.	Fair.
42		Good.	Fair.
*43	Rebuild at once	Bad.	Fair.
44	44-46 combined	Fair.	Poor.
45		Fair.	Fair.
46		Fair.	Poor.
§47	Rebuild soon	Poor.	Poor.
48	Rebuilt in 1887-8	Good.	Good.
49		Fair.	Poor.
50		Good.	Fair.

Number.	REMARKS.	GENERAL CONDITION. Alignment.	GENERAL CONDITION. Stone (quality).
§51	Rebuild soon	Bad	Poor.
§52	Rebuild soon	Fair	Very bad.
53		Fair	Poor.
§54	Rebuild soon	Bad	Fair.
*55	Rebuild at once	Bad	Poor.
56		Good	Poor.
57		Good	Poor.
*58	Rebuild at once	Poor	Fair.
*59	Rebuild at once	Bad	Fair.
60	Rebuilt in 1888-89; 58, 59 and 60 are combined	Good	Good.
61		Poor	Bad.
62		Fair	Fair.
63		Fair	Poor.
64		Fair	Bad.
65		Poor	Poor.
66		Fair	Poor.
67		Good	Fair.
68		Fair	Fair.
69		Good	Poor.
70		Good	Fair.
71-75		Good	Good.
*76	Upper of 4 combined; settled badly; rebuild at once	Bad	Good.
77-86		Good	Good.
87	Bad foundation; 87, 88, 89, 90, combined	Good	Good.
88		Good	Good.
89	Hole in bottom	Good	Good.
90-109		Good	Good.
Otter creek*	Rebuild at once from low water-line	Good	Timber very bad.
Bush's		Good	Good.

WALLS AND BANKS.

The usual ordinary repairs have been made to walls and docking. Some work has been done in strengthening the banks and raising low places, but not much more than is necessary to preserve existing conditions.

The condition of banks on the Oswego and other lateral canals remains practically as before. The question of removing bench walls on the Erie has been treated under the head of "Improvement of Channel," as that seems the most natural connection.

On the Erie canal, the vertical walls from the east end of the division nearly to the center of the city of Utica are in a very bad condition, as is the case at numerous other places along the whole length of the division. The upper part of the slope wall on the berme side is generally in bad condition, having been washed out by swells until it affords no protection to the banks.

On the Oswego canal, the river wall forming the berme bank of the canal between Locks Nos. 17 and 18, is in very bad condition. An appropriation was made by chapter 226, Laws of 1891, to complete the reinforcement of this wall, but nothing has been done. The law is so drawn as to place the matter entirely in the hands of the Superintendent of Public Works.

As reported last year, at lock No. 13, Oswego canal, the high bank sloughs off during the spring thaws and heavy rains at all seasons. The material covers the towing path and at times runs into the lock chamber, causing serious embarrassment and delay to navigation. A dry retaining wall should be built at the rear of the tow-path to remedy this difficulty.

DITCHING AND DRAINING.

Small appropriations have been made for constructing and reopening the drainage ditches along the foot of slopes to prevent damages and claims therefor, which have heretofore proved so expensive to the State. These appropriations being insufficient for the entire work of this character, have been expended only where the liability of the State has been established by awards of damages, and only in the most important of these cases. An appropriation should be made next year, and annually thereafter, sufficient to construct and keep open these ditches in all places where, in the judgment of the State Engineer and Surveyor and Superintendent of Public Works, they are necessary.

Serious trouble frequently arises from the unsanitary condition of the old canal, which, in most cases on this division, forms stagnant pools. A sufficient appropriation should be made to provide ample outlet and drainage of these ponds, and authority given for the proper maintenance of the necessary ditches or other means of securing this result.

RECORD OF BRIDGES AND LEVELS.

We have a good record of the general ground plan dimensions of bridges, but I think a detail record of the measurements of all members is advisable.

That made in 1878 was found of great value in saving special journeys when repairs were needed or questions of strength, etc., arose, but it is now practically obsolete.

The bench-marks on the Erie were perfected last year and those on the lateral canals are now in progress.

SPECIAL SURVEYS.

The flow line of the Beaver River reservoir has been completed and maps made, both for use of Board of Claims and to file for reference.

The location of "blue line" and determination of outline and capacity of reservoir remains as before, no provision having been made for the necessary surveys. The uncertainty of the location of the "blue line" or boundary of State lands causes great inconvenience, and I have no doubt, leads to frequent encroachments. It is practically impossible at many points to determine the true location, and in some cases in the cities of Utica and Syracuse especially, nothing better can be done than to scale it from our map, on the scale of two chains to one inch, thus embodying the errors due to small scale and imperfect drawing and tracing. An appropriation should be made for this purpose and the line accurately determined and marked either with monuments or references to fixed structures. The accurate determination of the storage capacity and location of reservoirs would be of great assistance in regulating the supply of water during dry seasons when it is necessary to use the utmost economy in feeding the canal. A special appropriation should be made for this purpose.

Recommendations for the continuance of uncompleted work, where appropriations have been exhausted or are insufficient will be found under the appropriate heading of the chapter under which the work has been done and for new work under "Repairs Needed."

APPROPRIATIONS OF 1888.

CHEMUNG CANAL.

Chapter 416.

Constructing a basin at Havana and reopening the Seneca Lake level.

The work has been completed to the extent of the appropriation and final accounts rendered. The work done comprises a swing-bridge at Watkins; the piling, embankment and part of the excavation of the basin at Havana; the construction of a new channel for Catharine creek at Havana, which was found necessary to prevent the filling of the canal at that point as fast as the material was removed; and dredging a portion of the lake level. This latter item is of no permanent value as it was done before the correction of the creek channel, and the cut dredged has nearly filled up. The work is in such condition now to be of little practical use, but so as to make it practicable to complete and maintain a good channel from the lake to Havana basin. An additional appropriation should be made for the completion of the work and repairing the piers, etc., at the entrance to the canal.

APPROPRIATIONS FOR 1889.

ERIE CANAL.

Chapter 568.

Deepening the canal to standard depth.

The balance of the appropriation has been judiciously expended by the Superintendent of Public Works.

Chapter 570.

Raising and widening abutments of West Genesee street bridge, Syracuse.

Nothing has been done, as no plan for the railroad connections which rendered this work necessary were perfected. The appropriation has lapsed.

OSWEGO CANAL.

Chapter 151.

Repairing State dam at Baldwinsville.

The unusual high water, which continued during the whole period of the availability of the appropriation has prevented any repairs being made and the appropriation has lapsed.

This dam is in wretched condition. The last extensive repairs were made in 1882, when both ends were repaired, but the central portion was not. During last summer several large leaks have occurred at different points, showing that the whole structure is decayed, so much so that I am doubtful if any repairs can be made to advantage. It should be rebuilt from the foundation. Both the law and the principles of business require it to be of stone when rebuilt. An appropriation for that purpose should be made during the coming session of the Legislature.

Chapter 568.

Deepening the channel to standard depth. Nothing done except ordinary cleaning.

Deepening the Oneida river improvement. The work has been completed to the extent of the appropriation and a final account rendered.

CAYUGA AND SENECA CANAL.

Chapter 150.

Repairing second level and State ditch at Seneca Falls.

Nothing has been done under this act and the appropriation has lapsed. The ditch was cleaned out by the Superintendent of Public Works from other funds.

BLACK RIVER CANAL.

Chapter 274.

Reservoir above Forestport pond.

The bulkhead and masonry abutments for dam are completed. The embankments connecting the masonry with the shores are practically done except that the one leading from the bulkhead will have to be raised with lining and faced with slope wall.

The channels leading to and from the bulkhead are three-fourths excavated and sufficient slope and vertical wall constructed to protect the work. The appropriation is exhausted and work stopped. The final account is nearly completed.

Chapter 568.

General improvement. Rebuilding Lock No. 12. The final account for this work exceeded the appropriation, so an amended account to the extent of appropriation was made in October, 1890.

MISCELLANEOUS.

Chapter 155.

Repairing State embankment at Sherburne (Mad Brook). Nothing done. Appropriation lapsed.

Chapter 204.

Improving harbor at foot of Canadaigua lake.

The work was completed to the extent of the appropriation previous to September 30, 1890. A final account has since been rendered.

About 300 lineal feet of the lake end of breakwater remains to be filled with stone in order to complete the work. For the security of the work an appropriation should be made to complete it.

The following are placed solely in charge of the Superintendent of Public Works:

Chapter 166.

Fishway on dam across Chittenango creek, near Bridgeport. Nothing done. Appropriation has lapsed.

Chapter 436.

Repairing highway near Castorland, Lewis county. The appropriation has been expended.

Chapter 570.

Repairing road crossings on the abandoned Oneida Lake canal. Nothing done.

APPROPRIATIONS OF 1890.

ERIE CANAL.

Chapter 81.

Stone culvert over old Erie canal at South James street in the city of Rome.

Contract canceled and final account rendered. An appropriation should be made to build a bridge at this point as recommended in last year's report.

Chapter 168.

Lengthening locks. Lock No. 46 to be lengthened at the head on the towpath side. Let July 8, 1890. The work has been satisfactorily completed and final account rendered. This completes the lengthening of one tier of locks on the middle division.

Chapter 338.

Reappropriation of certain unexpended balances. Schuyler street bridge, Utica. Nothing done under this chapter. It is superseded by chapter 69 of 1891, which see.

Chapter 385.

To improve the sanitary condition of the abandoned old Erie canal in the city of Rome. The improvement of Wood creek as the preliminary to the improvement of the old canal has been made by the Superintendent of Public Works, who with the board of health, of the city of Rome, has charge of the work.

OSWEGO CANAL.

Chapter 168.

Lengthening locks. Lock No. 8 to be lengthened at the foot and lock No. 12 to be lengthened at the head, were let July 8, 1890. Both have been satisfactorily completed and final accounts rendered.

CAYUGA AND SENECA CANAL.

Chapter 168.

Improvement of the Cayuga and Seneca canal. Nothing done. I would renew my recommendation of last year, to build a submerged dam, with waste-gates on top, extending the whole length, in place of the present loose-stone dam at Demont's, about one and one-fourth miles west of lock No. 8.

BLACK RIVER CANAL.

Chapter 168.

Improvement of the Black River canal. The partial rebuilding of lock No. 1 was let July 8, 1890. On tearing down the old walls it was found the more extensive repairs were needed for which the appropriation was insufficient. It was therefore supplemented with an additional appropriation by chapter 143 of 1891. It was discovered that nearly the whole foundation was undermined and the puddle under and between the timbers washed out, producing a settlement of the wall for about half the length of the chamber at the lower end. The timbers were taken up as far as the wall had settled, concrete placed under and between them after they were replaced. Above this the wall was apparently in place and the timbers of proper height, though the puddling was mostly gone. Concrete was rammed into the vacant spaces and the whole made thoroughly secure, after which the foundation was replanked and lined and the walls were relaid. The work was completed in a satisfactory manner and a final account has been rendered.

MISCELLANEOUS.

Chapter 295.

Surveys for the Board of Claims. Under this act, the survey of the Beaver river reservoir has been continued; amount expended $487.42. Also $652.88 has been expended on miscellaneous work as follows: Erie canal, $372.58; Oswego canal, $280.30.

APPROPRIATIONS OF 1891.

ERIE CANAL.

Chapter 69.

Swing-bridge near Schuyler street, Utica, over the Erie canal. Separate contracts were let on August 19, 1891, for the substructure and superstructure. No work has been done to my knowledge.

Chapter 241.

Building of sidewalks to be attached to a bridge crossing the Erie canal at Depuyster street in the city of Rome. The work was let July 20, 1891. No work has been done to my knowledge.

Chapter 302.

Surveys for Board of Claims. Under this act the survey of the Beaver river reservoir has been completed and maps of the same made; amount expended, $129.23. Also, $608.64 expended on miscellaneous work, as follows: Erie canal, $392.13; Chemung canal, $216.51. The appropriation for this purpose is insufficient and, in consequence, a large proportion of the work is paid for out of the "ordinary repair" fund. It should be increased to $10,000 yearly.

Chapter 341.

Removal of Genesee street bridge over the Erie canal, in the city of Utica, and erection of an iron bridge and hoist or lift-bridges. Survey and map of location have been made and plans are in progress.

BLACK RIVER CANAL.

Chapter 143.

Improvement of the Black River canal. This appropriation has been applied to the partial rebuilding of lock No. 1, Black River canal, let under chapter 168, Laws of 1890.

Chapter 342.

Clearing the flow-ground of the reservoir above Forestport. The work was advertised, but not let, June 30, 1891, as the bid was above the available appropriation. Surveys are now in progress to mark the limit of flow and clearing and locate the land lines within the same.

The following are directly in charge of the Superintendent of Public Works.

ERIE CANAL.

Chapter 282.

State ditches in the town of Mentz, county of Cayuga. Nothing done.

U OF M

OSWEGO CANAL.

Chapter 226.

Completion of the canal wall between the Oswego canal and the Oswego river, in the city of Oswego. Nothing done.

MISCELLANEOUS.

Chapter 205.

Completion of the repairs to highway near Castorland, Lewis county. Nothing done to my knowledge.

Chapter 240.

Completion of the repairs to highways near Beache's bridge, Lewis county. Nothing done to my knowledge.

ORDINARY REPAIRS MADE DURING THE FISCAL YEAR—ERIE CANAL.

Aqueducts.

No. 1, Sauquoit, trunk rebuilt.

No. 3, Cowassolon, new sides.

No. 5, limestone, general repairs.

No. 6, butternut, general repairs.

No. 8, Jordan, trunk rebuilt.

No. 9, Centerport, berme side renewed.

No. 12, Seneca river, towpath side and bottom, one span, renewed.

Bridges.

No. 81, rebuilt with iron chords.

No. 144, rebuilt.

No. 8, rewooded and I beams substituted for skeleton needlebeams.

Nos. 14, 25, rewooded.

Nos. 69, 105, 106, replanked and new joists.

Nos. 4, 6, 10, 11, 12, 13, 19, 21, 22, 29, 33, 38, 46, 48, 53, 56, 75, 94, 103, 114, 133, 134, 136, 141, replanked.

No. 120, sidewalk repaired.

No. 16, general repairs in connection with lengthening of lock No. 46.

Nos. 17, 97, 100, 104, 140, general repairs.

Bulkheads and waste-weirs.

No. 3. Fort Bull was thoroughly repaired and masonry pointed.

No. 5. Oneida creek bulkhead rebuilt.

Bulkhead at DeRuyter reservoir was rebuilt and pipes through dam repaired.

Culverts.

No. 1. Abutment and pier of west arch have been repaired in the same manner as those of the other arches were in 1888. The whole culvert is now in safe condition.

Locks.

No. 47. New tumble-gate towpath lock.

Weigh-lock at Syracuse. Four balance-beams.

No. 50. Two lower gates towpath lock.

OSWEGO CANAL.

Bridges.

Nos. 11 1-4, 18, 27. Rebuilt.

No. 6. Rewooded.

Nos. 5, 5 1-2, 15, 17, 19, 23, 29, on main line, No. 6 on Baldwinsville side-cut, and the swing-bridges at Oak Orchard and Caughdenoy, on the Oneida river improvement have been replanked.

No. 2. Sidewalks replanked and coped.

No. 20. General repairs.

No. 16. Saddles renewed.

The private suspension bridge above guard-lock No .3 has been taken down.

Bulkheads and spillways.

Bulkheads at each end of Van Buren dam, rebuilt.

Spillway No. 5. General repairs.

Spillway No. 6. Rebuilt.

Spillway No. 7 1-2 (below lock No. 13). Bank strengthened.

Spillway No. 8. Bank strengthened.

Culvert.

Culvert No. 2 has been cleaned out.

Dams.

High dam. Crib built below dam on east side and loose stone filled in above dam.

Locks.

No. 1. One lower gate.

No. 3. One upper gate.

Guard-lock No. 2. Two upper gates.

Lock No. 8. Repointed.

Side-cut lock, Fulton. Two lower gates.

Lock No. 9. Foundation grouted, replanked and lined, and puddle cutoffs put in on berme side.

Lock No. 12. Repointed.

Lock No. 15. One balance-beam.

Guard-lock No. 5. Foundation connected and repaired and new miter-sills put in.

Lock No. 18. One balance-beam.

Lock on Baldwinsville side-cut. Four new gates, and walls repaired.

Spillway No. 2 and that on north side-cut repaired.

CAYUGA AND SENECA CANAL.

Bridges.

No. 13. Rebuilt of iron.

No. 1. Replanked and new joists.

No. 14 and towpath bridges Nos. 7 and 8 and part of towpath bridge No. 12. Replanked.

No. 6. Has been raised and repaired.

Towpath bridge No. 10. Repaired.

No. 12. Painted.

Lock.

No. 1. Two upper and one lower gates.

Sluices.

No. 14. Replanked.

BLACK RIVER CANAL

Aqueducts.

No. 3. Willis creek. New trunk.

Bridges.

No. 2. New sidewalks.

Nos. 8, 10, 21, on main line, Naumberg (No. 4 1-2) on Beaver river and one span of Whittleseys (No. 1)on Black river improvement. Replanked.

No. 12. New bents and replanked.

Nos. 33 and 37. New bents.

Nos. 36 and 45. New needle-beams and joists.

No. 38. Painted.

No. 39. New stone abutment, north end, in place of wooden bent.

Bulkheads and spillways.

Spillway No. 1, general repairs.

Bulkhead No. 1, at Lansingkill dam, rebuilt.

Bulkhead No. 4, general repairs.

Locks.

Nos. 93 and 108, bottom concreted and replanked and two miter-sills put in.

Nos. 6, 15, 16, 19, 39, 41, 43, 49, 56, 57, 58, 59 and 66, foundation replanked.

No. 72, lower miter-sill put in and foundation replanked.

Nos. 63 and 73, bottom repaired.

No. 71, berme lower wing and sluice rebuilt.

Nos. 74, 85 and 92, lower miter-sill put in.

Nos. 80, 94 and 98, one miter-sill put in.

Nos. 86, 87 and 99, sluice repaired.

Nos. 7 and 31, two new gates.

Nos. 24, 28, 30, 37, 46, 55 and 67, one new gate.

No. 48, new spillway.

Nos. 23, 24, 61, 64 and 65, general repairs.

REPAIRS NEEDED — ERIE CANAL.

Aqueducts.

Aqueducts all need pointing.

No. 1, Sauquoit. Protect berme bank with brush and stone.

No. 2, Oriskany. New sides and planking on bottom.

No. 4, Chittenango. Replank sides and clean out channel of creek.

No. 6, Butternut. Repair masonry on berme side, west end.

No. 7, Camillus. Replank sides.

No. 9, Centerport. New trunks.

No. 10, Port Byron. New berme side.

No. 11, Crane Brook. Concrete bottom; replank and line foundation; new sides; relay west abutment and build new trunk on west span.

Bridges.

Nos. 2, 26, 46, 48, 57, 66, 80, 82, 113, 117, 123, 124 and bridge over Camillus feeder, rebuild.

No. 88, rewood and put railing on approaches.

Nos. 34, 35, 92, 93, 101, 115, 142 and tow-path bridge over Rome feeder, rewood.

No. 9, replank and general repairs.

No. 77, replank and new coping and railing on north approach.

Nos. 7, 24, 36 1-2, 37, 39, 45, 65 1-2, 67, 86, 90, 98, 130, 138, 143, 145, replank.

Nos. 135 and 136, new sidewalk.

Nos. 21, 28, 133, replank sidewalks.

Nos. 42, 79, 91, new joists and plank.

No. 83, new joists and railing on south approach.

Nos. 75, 137, new joists.

No. 58, new coping.

Nos. 59, 100, general repairs.

No. 25, new iron needle-beams in place of wood.

Nos. 109 and 110. Painting towpath bridge over all feeder at Rome. Fill in and make towpath continuous. Take down the private foot bridge No. 85. It is dangerous.

Bulkheads and waste-weirs.

No. 1. Ballou, rebuild bulkhead and apron below overfalls and loose stone protection below apron.

No. 2. Clarks, reline apron.

No. 4. Higginsville, rebuild on towpath side and enlarge culvert. See last year's report for reasons.

No. 6. Pool's brook, rebuild bulkhead.

No. 7. Carpenter brook, rebuild bulkhead and repairing masonry.

No. 8. Putnam brook, rebuild bulkhead and repair masonry and puddle embankment at ends.

Rebuild bulkhead in Mohawk feeder at Rome.

Rebuild bulkhead at dam on Chittenango feeder.

Rebuild waste-weir on Limestone feeder.

Rebuild bulkhead and gates at Camillus dam.

Culverts.

No. 2. Strip and rebuild bench walls and arch of south half.

Nos. 4, 5, 6, 8, 27, 43 and 74. Rebuild towpath end (masonry), and point berme end.

Nos. 28, 29, 32, 40. Rebuild both ends.

Nos. 13 and 26. Rebuild and enlarge (present culverts are too small to carry the streams in large freshets). Waste-weir mentioned above.

Nos. 20, 21, 33, 39, 45, 48, 49, 57, 58, 61, 62 and 73. Point masonry and general repairs.

Nos. 3, 7, 11, 12, 22, 34, 35, 36, 50 and 64. Point masonry.

Nos. 38, 53. Protect apron and point masonry.

No. 41. Foundation concreted (berme end), and masonry relaid.

No. 42. Rebuild berme end.

Docking.

Rebuild 700 lineal feet east of road bridge No. 32, and 1,000 lineal feet east of road bridge No. 34.

Feeders and dams.

Oneida. Clean out and repair banks.

Bradley brook feeder. Clean out and raise banks, and raise dams in Bradley brook.

At junction of Bradley brook feeder, with Chenango river, new bulkhead.

The dams on Oriskany and Cowassalon creeks need general repairs. A retaining wall is needed on the river bank above the Mohawk dam at Rome.

At Skaneateles lake outlet the east pier needs filling with loose stone, and the channel leading to dam cleaned out, in order to render the full capacity available.

Locks.

No. 46. Two lower gates, towpath lock.

No. 47. New tumble-gate, berme lock and two balance-beams.

No. 48. New tumble-gate and check studs, berme lock; two new gates for towpath lock (provided for).

No. 49. Four new lower gates.

Weigh-lock, Syracuse. New miter-sill, east end.

Rebuild pier at west end.

Lock No. 51. Two middle gates, berme lock. Two spier gears.

Receiver.

No. 1. On berme west of Centerport. Rebuild.

Reservoirs.

Madison brook. New bulkhead in feeder.

Eaton. Gates repaired and stems in the deep well brought up to the top. As now arranged, it is necessary to go nearly to the bottom of the well to open the gates. In case of imminent danger from cloud burst or other cause by which the water is suddenly raised so as to threaten an overflow of the bank, this well would be filled with water before the dam was in serious danger, as its top is several feet below the crest of the dam.

Bradley brook. Dam raised two feet and a new spillway, overfalls and open conduit for same of stone. The dam is of earth, well built and secure, but not high enough from crest of spillway. It is not desirable to lower the latter as it would reduce the storage capacity. The present spillway is of wood and must soon be rebuilt, when stone should be used to make a more permanent structure.

Hatch's lake. New bulkhead, stone abutments.

Kingsley's brook. New bridge abutments, bridge and bulkhead at south (or right) end of dam, extend discharge pipes to lower side of dam, and build gate-house there. The present bridge abutments are merely a face wall of stone built against, but not bonded with the rock which was excavated to give the discharge way from bulkhead. New abutments are needed, made thick enough to allow thorough bonding and give strength enough independent of the natural rock. A highway crosses on the crest of the dam and the bulkhead is directly at the upper side of the bridge. Both bulkhead and bridge are unsafe.

Jamesville. Strengthen and protect foot of dam and make a new channel for waste water, parallel with dam from spillway to natural channel of the creek, as recommended in 1888.

Skaneateles. Clear out channel leading to the dam and fill east pier with loose stone.

Spillways.

At Amos mill, Syracuse, raise to standard height (seven feet above canal bottom).

Slope wall. Replace bench walls with full height slope wall on Rome, Syracuse and Jordan levels. Repair top of wall generally.

Vertical wall.

Rebuild berme wall from Green's road bridge (No. 1) to Broad street, Utica. It is in very bad condition, as is the case at many other points in the city of Utica. At Reausseau's lumber yard, in Rome, rebuild 210 lineal feet.

Four hundred lineal feet on berme east of Stearn's farm bridge (No. 83) has fallen into the canal.

General repairs are need at other points.

Provision should be made for about two and one-half miles.

Miscellaneous.

The gates should be taken out of old dry-dock at Grove Spring, and the berme bank built across the opening.

The tumble-gate at entrance of new Oneida Lake canal should be taken out and towpath bank built across the opening.

The bank (towpath) east of Salt street bridge, Montezuma, should be loaded with brush and stone to prevent sliding.

OSWEGO CANAL.

Bridges.

No. 9. Rebuilt.

Float-bridge on Seneca river towing-path. Rebuilt with pile-bents.

No. 13. Rewood.

Nos. 2, 8, 14 and 31, Main line, No. 1. South side-cut; Nos. 1, 2 and 3, north side-cut and bridge at Jack's Reefs. Replank.

Nos. 7 and 5, Baldwinsville side-cut. New sidewalks and coping.

No. 22. New sidewalk, south side.

Bulkheads.

No. 1, above lock No. 5. New bridge at west end of Oswego Falls dam, and at west end of High dam rebuilt (both provided for).

Culverts.

No. 5, between locks 17 and 18. Rebuild toward towpath end and reinforce parapet walls. (There is an appropriation of $10,000 for this and repairing river wall on the same level. There should be $5,000 more.)

Dams.

Oswego dam. Build new sloping apron. This should be done by the Superintendent of Public Works, not by contract.

Baldwinsville dam should be rebuilt of stone.

Caughdenoy dam should be rebuilt of stone.

Locks.

Sluices around Nos. 1 and 2. Rebuild upper end.

No. 2. One lower gate.

No. 5. Two lower gates (provided for).

Guard lock No. 2. Fender-plank in recesses.

No. 9. One lower gate.

No. 11. One balance-beam.

Guard-lock No. 4. Two lower gates (provided for).

No. 13. Clean out mud in chamber and build retaining wall on rear of towpath to keep the mud out of the lock.

No. 14. New lock-house and two lower gates.

Lock at Caughdenoy, Oneida river improvement. Two upper gates.

Two guard-gates at Baldwinsville.

Piers.

At outlet of Onondaga lake. Rebuild.

River wall.

Reinforce and repair lower end of wall between locks 17 and 18. There is an appropriation for this.

Retaining walls.

Above bridge No. 19 (Hinmanville). Rebuild.

In rear of towpath, lock No. 13. New wall needed.

Sluices.

Rebuild No. 1 near lock No. 5.

Spillways.

No. 1, at Haskin's mill. Raise to standard height.

No. 2, between locks Nos. 2 and 3. Rebuild.

No. 7. Above lock No. 10. Rebuild.

CAYUGA AND SENECA CANAL.

Bridges.

No. 9, towpath bridges Nos. 3 and 11 and over spillway No. 1. Rebuild.

Nos. 3, 12. Rewood.

No. 5. Rewood and railings west approach.

Nos. 1, 2, 6, 8. Paint.

No. 4. Roadway repairs.

No. 7. General repairs.

Nos. 8, 15, 17, stringer-bridge over race Seneca Falls, towpath bridges Nos. 6, 12, 13 and Seneca street, Ithaca. Replank.

Nos. 10, 16, 18. Replank and new joints.

No. 11. New sidewalks.

No. 14. One needle-beam.

No. 19. One new wheel.

Buffalo street, Ithaca. Level track and secure center pier.

Dams.

No. 2. Rebuild one-fourth of the apron on Seneca Falls dam and repair the rest of it.

No. 3, distillery dam. General repairs.

No. 4, Demonts. Rebuild as a submerged dam, with waste-weir on crest.

Fences.

Build fences along highway between sluices 1 and 2, one-third mile.

Locks.

No. 1. One lower gate.

No. 3. Two lower gates and bridge at foot.

No. 4. Rebuild chamber wall on south side.

No. 6. Replank bottom; new fenders; two balance-beams.

No. 9. Two lower gates.

No. 10. Fenders; coping and four balance-beams.

No. 11. Two balance-beams; repair flume.

Piers.

Cayuga pier needs general repairs.

Retaining walls.

Above lock No. 3. General repairs and pointing.

Between locks Nos. 3 and 4. Rebuild.

Sluices.

No. 13. Rebuild.

Nos. 16, 17, 18 and 19. Replank.

BLACK RIVER CANAL.

Aqueducts.

No. 1. New trunk; point masonry.

No. 2. New trunk; point masonry.

No. 3. New pier; point masonry.

No. 4. Repair masonry and point it; stone very poor.

No. 5. Repair masonry and point it and clean channel.

No. 6. Point masonry.

Bridges.

Paint all bridges not lately painted.

No. 60. Rebuild, including bents.

Nos. 53, 58 and 1, 2, 3 and 4 on Delta feeder. Rebuild.

Nos. 19, 27 and 29. Rewood.

No. 17. Replank and new bents.

Nos. 6, 9, 11, 17 and 44. One new bent.

Nos. 1, 2, 3, 18 and 22 and junction bridge, Moose and Black river. Replank.

No. 30. Rebuild stone abutments.

No. 28. Rebuild T. P. abutment.

No. 39. Build stone abutment at south end.

Nos. 20, 25, 31 and 50. New bents (provided for).

Nos. 5, 19 and 61. Iron needle-beams and joists.

BLACK RIVER IMPROVEMENT.

Bridges.

No. 1. Whittleseys, rebuild swing with iron. Repair west pier and drive fender piles about it, relay and clamp coping under track and rack, build end abutment (for swing) with stone and point masonry.

No. 2. Glendale, rebuild all with iron, replace coping on outer circle with new stone and build end abutment (for swing) of stone.

No. 4. Illingsworth, rebuild swing with iron.

No. 5. Castorland, replace two (east) fixed spans with iron.

No. 6. Carthage, replace needle-beams with iron and correct bearings of diagonals.

FORESTPORT FEEDER.

No. 13. Rebuild.

Nos. 2, 3, 5, 7 and 11. New bents.

Nos. 1, 4 and 9. New berme bents.

No. 10. New chord west truss.

Culverts (main line).

No. 3. Halls, a receiver should be built in the brook above the culvert to collect the shale which now fills the culvert and channel below in every freshet.

No. 4. Replace coping with new stone.

No. 5. Relay coping.

No. 7. Repair foundation and relay masonry on towpath and point masonry on berme.

Dams and bulkheads.

Lansing kill, repair apron, build wing dam of cribs on east side to throw current toward feeder, and point masonry.

Otter creek (river improvement), relay vertical wall at west end and point masonry.

Bush's (river improvement), point masonry and fill hole in embankment at west end.

Bulkhead No. 5. Main line, rebuild.

Bulkhead No. 7. Relay wings, repair foundation and point masonry.

Bulkhead No. 3 (Forestport feeder). Rebuild.

Locks.

Nos. 3, 7, 13, 18, 28, 32, 33, 34, 35, 37, 39, 40, 43, 47, 51, 52, 54, 55, 58, 59 and 76. Rebuild.

Otter creek lock (river improvement), rebuild from low water line including docking.

Nos. 2, 9, 14, 17, 20, 21, 22, 24, 25, 26 and 27. Replank foundation.

Nos. 23, 30, 87 and 89. Repair foundation.

Nos. 2, 23, 28, 70, need one new gate each (provided for).

Nos. 22, 30, 42 and 43, need one new gate each.

No. 4. Rebuild docking at head.

No. 9. New hollow quoin coping.

Nos. 81, 82, 83, 84 and 86. Point masonry.

No. 37 was chipped to pass boats this season.

No. 76 is the upper of four combined foundation undermined, and walls settled badly.

Three lock houses on section No. 1.

Prism.

Nearly the whole canal needs bottoming out, and receiver dam built above the canal on all streams which bring down debris.

Spillways.

No. 3. Rebuild.

SUMMARY OF RECOMMENDATIONS REQUIRING SPECIAL APPROPRIATIONS OR USE OF APPROPRIATIONS ALREADY MADE.

Erie Canal.

Vertical wall in Utica at Reausseau's lumber yard in Rome and near Stearn's bridge No. 83. (See "Repairs Needed.")

Culvert at South James street, Rome. (See "Appropriations of 1890, chapter 81.")

Culvert No. 13, Whitehall. Rebuild and enlarge. (See "Repairs Needed," Erie Canal Culverts.)

Waste-weir No. 4 and culvert No. 26, Higginsville. Rebuild on change of plan.

Replacing old bench walls with full height slope walls. (See "General Report, Improvement of Channel.")

Enlargement of Port Byron feeder. (See "General Report, Water Supply.")

Oswego Canal.

Retaining wall at lock No. 13. (See "General Report, Walls and Banks.")

Completing river wall and culvert, between locks Nos. 17 and 18. (See "General Report, Walls and Banks," and "Repairs Needed, Oswego Canal.")

Appropriation is insufficient to complete the work.

Sloping apron, Oswego dam. (See "Repairs Needed, Oswego Canal.")

Rebuilding dam at Baldwinsville with stone. (See "Appropriations of 1889, chapter 151.")

Cayuga and Seneca Canal.

Rebuilding Demonts dam. (See Appropriation of 1890, chap. 168, C. & S. canal.)

Black River Canal.

Rebuilding locks. (See general report, "Structures.")

Willis creek aqueduct. (See "Repairs Needed.")

Iron bridges on the Black river improvement. (See "Repairs Needed.")

Receivers on brooks emptying into canal. (See "Improvement of Channel." General report.)

Reservoirs.

Forestport new reservoir. (See "General Report." Water supply.)

Improvement and repairs of reservoirs and feeders. (See general report, "Water Supply and Repairs Needed."

Surveys and reservoirs. (See general report, "Special Surveys.")

General.

Bottoming out and raising banks. (See general report, "Improvement of Channel" and "Walls and Banks.")

Resurvey and marking of "Blue Line." (See general report, "Special Surveys.")

Surveys of bridges. (See general report, "Record of Bridges and Levels.")

Clearing ditches. (See general report, "Ditching and Draining.")

Draining old Erie canal. (See general report, "Ditching and Draining.")

Surveys for Board of Claims. (See "Appropriations of 1891, chap. 302.")

Machinery for hauling boats into locks. (See "General Report.")

Miscellaneous.

Havana basin and opening lake level of the Chemung canal to navigation. (See "Appropriations of 1888," chap. 416.)

Completing breakwater in Canandaigua harbor. (See "Appropriations of 1889," chap. 204.)

ENGINEERING.

This division has been under the charge of Henry T. Beach, as division engineer, and David E. Whitford, as resident engineer.

The extraordinary work has been so scattered as to require a seemingly large force of assistants, and has caused a large expense for travel, which, however, has been kept as low as was consistent with the proper performance of the work.

Considerable time has been spent in making surveys and maps, and collecting data for the Board of Claims, which has been done under the special appropriation for that purpose.

Maps, plans and specifications have been made for most of the new work, and others are in course of preparation. Work done under ordinary repairs has been promptly attended to.

I attach table No. 1, showing distribution of engineering expenses, No. 2, showing status of construction work under special appropriations, and No. 3, giving the water record of Cayuga and Cross lakes and Seneca river, as per concurrent resolutions of 1884.

This record does not accomplish the desired object, if I understand it correctly. The dates of measurements are fixed by the resolution, and do not show either highest or lowest water, nor do the results afford any comparison between the original and present condition of the lakes and river. If it is desirable to continue these measurements, self-registering gauges should be set at the specified points, which would give a complete record of the fluctuations of the water.

The comparative condition can not be obtained, as no records exist of the state of lakes and river channel before the attempted improvement of the river channel. I doubt if any good result will follow the continuance of these measurements.

I also attach table No. 4, giving corrected record of structures, and table No. 5, giving corrected description and elevation of bench marks on this division, as far as completed

All of which is respectfully submitted.

H. T. BEACH,
Division Engineer.

TABLE No. 1.

Statement showing the names, rank and compensation of engineers employed on the middle division of the New York State canals, together with the incidental expenses for the fiscal year ending September 30, 1891.

ORDINARY REPAIRS — ERIE CANAL.

Chapter 266, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.	Amount.
H. T Beach	Division engineer	....	$2,400 00 per annum	$975 36	$73 37	$1,048 73	
D. E. Whitford	Resident engineer	....	2,000 00 per annum	522 77	76 03	598 80	
Charles G. Witbeck	Assistant engineer in charge	51	6 00 per day	306 00	19 88	325 88	
R. R. Stuart	Assistant engineer in charge	46	6 00 per day	276 00	105 04	381 04	
J. M. Farley	Assistant engineer	89	5 00 per day	445 00	59 88	504 88	
A. C. Driscoll	Leveler	39	4 50 per day	175 50	21 78	197 28	
Charles A. Cockroft	Leveler	25	4 50 per day	112 50	12 38	124 88	
A. V. Meeker	Rodman	2	3 50 per day	7 00	15 86	22 86	
Theo. A. Hendrickson	Rodman	51	3 50 per day	178 50	69 00	247 50	
S. L. Way	Rodman	42	3 50 per day	147 00	42 22	189 22	
N E. Whitford	Rodman	19	3 50 per day	66 50	16 96	83 46	
Henry Blum	Chainman	296	4 00 per day	1,184 00	22 92	1,206 92	
T. V. Owens	Chainman	29	2 50 per day	72 50	37 42	109 92	
M. J Ross	Chainman	71	2 50 per day	177 50	33 48	210 98	
E. J. Waldron	Chainman	4	2 50 per day	10 00	....	10 00	
Joseph Sweeney	Chainman	5	2 50 per day	12 50	6 43	18 93	
							$5,281 28
Incidental expenses.							
Stationery						$386 08	
Fuel and light						97 98	
Postage and telegraph						95 88	
Labor						2 00	
Miscellaneous						749 33	
							1,331 27
Total ordinary repairs, Erie canal							$6,612 55

OSWEGO CANAL.

NAME.	Rank.	Number of days	Rate of compensation.	Salary.	Travel.	Total.	Amount.
H. T. Beach	Division engineer	....	$2,400 00 per annum	$505 00	$7 45	$512 45	
D. E. Whitford	Resident engineer	....	2,000 00 per annum	280 00	23 80	303 80	
R. R. Stuart	Assistant engineer in charge	30	6 00 per day	180 00	49 35	229 35	
J. M. Farley	Assistant engineer	44	5 00 per day	220 00	14 62	234 62	
A. C. Driscoll	Leveler	18	4 50 per day	81 00	13 90	94 90	
Chalres A. Cockroft	Leveler	7	4 50 per day	31 50	13 42	44 92	
A. V. Meeker	Rodman	70	3 50 per day	245 00	79 21	324 21	
Theodore A. Hendrickson	Rodman	11	3 50 per day	38 50	26 90	65 40	
N. E. Whitford	Rodman	20	3 50 per day	70 00	3 05	73 05	
T. V. Owens	Chainman	3	2 50 per day	7 50	2 70	10 20	
M. J. Rosa	Chainman	4	2 50 per day	10 00	3 76	13 76	
Joseph Sweeney	Chainman	1	2 50 per day	2 50	1 20	3 70	
							$1,910 36
Incidental expenses.							
Stationery						$165 19	
Postage and telegraph						50	
Miscellaneous						21 55	
							187 24
Total ordinary repairs, Oswego canal							$2,097 60

CAYUGA AND SENECA CANAL.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
H. T. Beach	Division engineer	....	$2,400 00 per annum	$200 00	....	$200 00
D. E. Whitford	Resident engineer	....	2,000 00 per annum	139 00	$9 07	148 07
R. R. Stuart	Assistant engineer in charge	13	6 00 per day	78 00	29 22	107 22
J. M. Farley	Assistant engineer	20	5 00 per day	100 00	27 20	127 20
N. E. Whitford	Rodman	2	3 50 per day	7 00	4 46	11 46
T. V. Owens	Chainman	6	2 50 per day	15 00	10 84	25 84
M. J. Ross	Chainman	10	2 50 per day	25 00	....	25 00
						$644 79
Incidental expenses.						
Postage and telegraph						50
Total ordinary repairs Cayuga and Seneca canal						$645 29

BLACK RIVER CANAL.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.	Amount.
H. T. Beach	Division engineer	....	$2,400 00 per annum	$312 00	....	$312 00	
D. E. Whitford	Resident engineer	....	2,000 00 per annum	176 00	$36 70	212 70	
Charles G. Witbeck	Assistant engineer in charge	15	6 00 per day	90 00	2 56	92 56	
R. R. Stuart	Assistant engineer in charge	18	6 00 per day	108 00	46 78	154 78	
J. M. Farley	Assistant engineer	37	5 00 per day	185 00	....	185 00	
A. C. Driscoll	Leveler	5	4 50 per day	22 50	2 00	24 50	
Charles A. Cockroft	Leveler	28	4 50 per day	126 00	2 45	128 45	
Theo. A. Hendrickson	Rodman	12	3 50 per day	42 00	....	42 00	
N. E. Whitford	Rodman	3	3 50 per day	10 50	....	10 50	
Henry Blum	Chainman	2	4 00 per day	8 00	7 10	15 10	
M. J. Ross	Chainman	27	2 50 per day	67 50	2 80	70 30	
							$1,247 84
Incidental expenses.							
Postage and telegraph						$0 50	
Miscellaneous						7 27	
							7 77
Total ordinary repairs, Black River canal							$1,255 61

EXTRAORDINARY REPAIRS — STONE CULVERT OVER OLD ERIE CANAL, ROME.

Chapter 81, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
H. T. Beach	Division engineer	2	$2,400 00 per annnum	$13 15	....	$13 15
John M. Farley	Assistant engineer	3	5 00 per day	15 00	....	15 00
A. C. Driscoll	Leveler	1	4 50 per day	4 50	$3 16	7 66
M. J. Ross	Chainman	1	2 50 per day	2 50	....	2 50
Total repairs stone culvert, etc., chap. 81, Laws of 1890						$38 31

LENGTHENING LOCKS—ERIE CANAL.

Chapter 168, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.	Amount.
H. T. Beach	Division engineer	5	$4,000 00 per annum	$32 88	$18 74	$46 60	
D. E. Whitford	Resident engineer	15	2,000 00 per annum	82 20	25 77	107 97	
Charles G. Witbeck	Assistant engineer in charge	117	6 00 per day	702 00	87 59	789 59	
G. D. Baltimore	Leveler	7	4 50 per day	31 50	....	31 50	
A. V. Meeker	Rodman	4	3 50 per day	14 00	9 11	23 11	
Theo. A. Hendrickson	Rodman	155	3 50 per day	542 50	53 48	595 98	
S. L. Way	Rodman	66	3 50 per day	231 00	12 82	243 82	
John Hickey	Rodman	112	3 50 per day	392 00	11 14	403 14	
Charles M. Pepson	Rodman	27	3 50 per day	94 50	....	94 50	
Henry Blum	Chainman	2	4 00 per day	8 00	7 07	15 07	
M. J. Rosa	Chainman	5	2 50 per day	12 50	7 28	19 78	
E. J. Waldron	Chainman	70	2 50 per day	175 00	28 75	203 75	
Joseph Sweeney	Chainman	144	2 50 per day	360 00	15 00	375 00	
G. B Hughes	Chainman	18	2 50 per day	45 00	....	45 00	
							$2,994 26
Incidental expenses.							
Stationery						$18 96	
Fuel and light						20 50	
Postage and telegraph						14 15	
Office rent						45 00	
Miscellaneous						9 65	
							108 26
Total lengthening locks, Erie canal, chap. 168, Laws of 1890							$3,102 52

BOTTOMING ERIE CANAL.

Chapter 168, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
John M. Farley	Assistant engineer	10	$5 00 per day	$50 00	$35 04	$85 04
Charles A. Cockroft	Leveler	7	4 50 per day	31 50	70 11	101 61
Theo. A. Hendrickson	Rodman	5	3 50 per day	17 50	25 00	42 50
M. J. Rosa	Chainman	12	2 50 per day	30 00	7 29	37 29
E. J. Waldron	Chainman	5	2 50 per day	12 50	1 00	13 50
						$279 94
Incidental expenses.						
Labor					$14 00	
Miscellaneous					19 22	
						33 22
Total bottoming Erie canal, chap. 168, Laws of 1890						$313 16

SURVEYS, STATE BOARD OF CLAIMS — ERIE CANAL.

Chapter 295, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Chas. G. Witbeck	Assistant engineer in charge	28	$6 00 per day	$168 00	$57 84	$225 84
Chas. A. Cockroft	Leveler	1	4 50 per day	4 50	....	4 50
Theo. A. Hendrickson	Rodman	7	3 50 per day	24 50	14 34	38 84
S. L. Way	Rodman	5	3 50 per day	17 50	8 76	26 26
Henry Blum	Chainman	4	4 00 per day	16 00	....	16 00
Henry Blum	Chainman	4	2 50 per day	10 00	....	10 00
M. J. Ross	Chainman	13	2 50 per day	32 50	14 34	46 84
						$367 78
Incidental expenses.						
Postage and telegraph					$0 25	
Labor					4 00	
Miscellaneous					55	
						4 80
Total surveys, etc., Erie canal, chap. 295, Laws of 1890						$372 58

IMPROVING SANITARY CONDITION OF THE OLD ERIE CANAL AT ROME.

Chapter 385, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
A. C. Driscoll	Leveler	7	$4 50 per day	$31 50	$29 82	$61 32
N. E. Whitford	Rodman	1	3 50 per day	3 50	2 58	6 08
M. J. Rosa	Chainman	6	2 50 per day	15 00	15 80	30 80
						$98 20
Incidental expenses.						
Miscellaneous					$1 25	1 25
Total improving sanitary condition, etc., chap. 385, Laws of 1890						$99 45

SWING OR LIFT BRIDGE AT SCHUYLER STREET, UTICA — ERIE CANAL.

Chapter 69, *Laws of* 1891.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
H. T. Beach	Division engineer	18	$2,400 00 per annum	$85 46	....	$85 46
J. M. Farley	Assistant engineer	1	5 00 per day	5 00	$3 16	8 16
A. C. Driscoll	Leveler	4	4 50 per day	18 00	....	18 00
Total swing or lift bridge at Schuyler street, Utica, chap. 69, Laws of 1891						$111 62

SURVEYS STATE BOARD OF CLAIMS — ERIE CANAL.

Chapter 302, *Laws of* 1891.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Charles G. Witbeck	Assistant engineer in charge	30	$6 00 per day	$180 00	$44 45	$224 45
J. M. Farley	Assistant engineer	4	5 00 per day	20 00	5 06	25 06
Charles A. Cockroft	Leveler	4	4 50 per day	18 00	8 06	26 06
Theodore A. Hendrickson	Rodman	18	2 50 per day	45 50	9 16	54 66
Henry Blum	Chainman	6	4 00 per day	24 00	....	24 00
E. J. Waldron	Chainman	7	2 50 per day	17 50	1 10	18 60
Joseph Sweeney	Chainman	7	2 50 per day	17 50	1 10	18 60
						$391 43
	Incidental expenses.					
Postage and telegraph					$0 35	
Labor					50	
Miscellaneous					50	
						1 35
Total surveys, etc., Erie canal, chap. 302, Laws of 1891						$392 78

LENGTHENING LOCKS — OSWEGO CANAL.

Chapter 168, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
H. T. Beach	Division engineer	6	$2,400 00 per annum	$46 08	$11 20	$57 28
D. E. Whitford	Resident engineer	54	2,000 00 per annum	295 91	20 37	316 28
R. R. Stuart	Assistant engineer in charge	217	6 00 per day	1,302 00	390 03	1,692 03
John M. Farley	Assistant engineer	38	5 00 per day	190 00	....	190 00
A. C. Driscoll	Leveler	219	4 50 per day	985 50	112 83	1,098 33
G. D. Baltimore	Leveler	27	4 50 per day	121 50	....	121 50
N. E. Whitford	Rodman	238	3 50 per day	833 00	20 56	853 56
Charles M. Pepson	Rodman	43	3 50 per day	150 50	8 32	158 82
Henry Blum	Chainman	1	4 00 per day	4 00	2 00	6 00
T. V. Owens	Chainman	186	2 50 per day	465 00	39 80	504 80
M. J. Rosa	Chainman	2	2 50 per day	5 00	4 13	9 13
						$5,007 67
Incidental expenses.						
Stationery					$25 57	
Fuel and light					38 55	
Postage and telegraph					29 85	
Office rent					65 00	
Miscellaneous					34 72	
						193 69
Total lengthening locks, Oswego canal, chap. 168, Laws of 1890						$5,201 36

SURVEYS STATE BOARD OF CLAIMS — OSWEGO CANAL.

Chapter 295, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
H. T. Beach	Division engineer	8	$2,400 00 per annum	$52 60	$12 42	$65 02
Charles G. Witbeck	Assistant engineer in charge	9	6 00 per day	54 00	44 52	98 52
John M. Farley	Assistant engineer	3	5 00 per day	15 00	50	15 50
A. V. Meeker	Rodman	2	3 50 per day	7 00	2 55	9 55
Theo. A. Hendrickson	Rodman	8	3 50 per day	28 00	14 75	42 75
Henry Blum	Chainman	1	4 00 per day	4 00	5 16	9 16
M. J. Ross	Chainman	10	2 50 per day	25 00	13 75	38 75
						$279 25
Incidental expenses.						
Postage and telegraph					$0 30	
Miscellaneous					75	
						1 05
Total surveys, etc., Oswego canal, chap. 295, Laws of 1890						$280 30

DAM AT HEAD OF FORESTPORT POND — BLACK RIVER CANAL.

Chapter 274, *Laws of* 1889.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
H. T. Beach	Division engineer	2	$2,400 00 per annum	$13 16	$11 41	$24 57
D. E. Whitford	Resident engineer	31	2,000 00 per annum	169 87	42 52	212 39
R. R. Stuart	Assistant engineer in charge	2	6 00 per day	12 00	6 60	18 60
A. C. Driscoll	Leveler	4	4 50 per day	18 00	9 37	27 37
Charles A. Cockroft	Leveler	222	4 50 per day	999 00	51 45	1,050 45
S. L. Way	Rodman	5	3 50 per day	17 50	5 40	22 90
N. E. Whitford	Rodman	4	3 50 per day	14 00	9 37	23 37
John Hickey	Rodman	29	3 50 per day	101 50	....	101 50
T. V. Owens	Chainman	44	2 50 per day	110 00	15 30	125 30
M. J. Rosa	Chainman	106	2 50 per day	265 00	27 75	292 75
						$1,899 20
Incidental expenses.						
Stationery					$0 10	
Postage and telegraph					4 15	
Office rent					30 00	
Miscellaneous					6 93	
						41 18
Total Forestport dam, chap. 274, Laws of 1889						$1,940 38

PARTIAL REBUILDING LOCK NO. 1 — BLACK RIVER CANAL.

Chapter 168, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
H. T. Beach	Division engineer	2	$2,400 00 per annum	$13 14	$3 62	$16 76
D. E. Whitford	Resident engineer	7	2,000 00 per annum	38 36	12 67	51 03
Chas. G. Witbeck	Assistant engineer in charge	60	6 00 per day	360 00	56 92	416 92
John M. Farley	Assistant engineer	8	5 00 per day	40 00	16 92	56 92
A. C. Driscoll	Leveler	2	4 50 per day	9 00	....	9 00
A. V. Meeker	Rodman	1	3 50 per day	3 50	3 86	7 36
Theo. A. Hendrickson	Rodman	62	3 50 per day	217 00	36 80	253 80
S. L. Way	Rodman	4	3 50 per day	14 00	4 70	18 70
John Hickey	Rodman	6	3 50 per day	21 00	8 35	29 35
M. J. Rosa	Chainman	2	2 50 per day	5 00	7 92	12 92
E. J. Waldron	Chainman	132	2 50 per day	330 00	7 56	337 56
Jos. Sweeney	Chainman	2	2 50 per day	5 00	4 38	9 38
						$1,219 70

Incidental expenses.

Stationery	$0 75	
Fuel and light	19 50	
Postage and telegram	7 35	
Office rent	50 01	
Miscellaneous	7 13	
		84 74
Total lock No. 1, Black River canal, chap. 168, Laws of 1890		$1,304 44

SURVEYS STATE BOARD OF CLAIMS — BLACK RIVER CANAL — FLOW LINE BEAVER RIVER RESERVOIR.

Chapter 295, *Laws of* 1890.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
H. T. Beach	Division engineer	6	$2,400 00 per annum	$39 45	....	$39 45
C. E. Phelps	Surveyor	57	5 00 per day	285 00	$57 45	342 45
Henry Blum	Chainman	2	4 00 per day	8 00	7 52	15 52
						$397 42
Incidental expenses.						
Labor					$84 00	
Miscellaneous					6 00	
						90 00
Total flow line, etc., chap. 295, Laws of 1890						$487 42

SURVEYS STATE BOARD OF CLAIMS — FLOW LINE, BEAVER RIVER RESERVOIR — BLACK RIVER CANAL.

Chapter 302, *Laws of* 1891.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
H. T. Beach	Division engineer	....	$2,400 00 per annum..	$92 05	$12 58	$104 63
C. E. Phelps	Surveyor	2	5 00 per day	10 00	7 10	17 10
						$121 73
			Incidental expenses.			
Miscellaneous					$7 50	7 50
Total surveys, flow line, Beaver River reservoir, chap. 302, Laws of 1891						$129 23

CLEARING RESERVOIR, FORESTPORT DAM — BLACK RIVER CANAL.

Chapter 342, *Laws of* 1891.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
D. E. Whitford	Resident engineer	5	$2,000 00 per annum	$27 40	$14 88	$42 28
J. M. Farley	Assistant engineer	1	5 00 per day	5 00	....	5 00
A. C. Driscoll	Leveler	17	4 50 per day	76 50	12 44	88 94
Chas. A. Cockroft	Leveler	19	4 50 per day	85 50	3 30	88 80
N. E. Whitford	Rodman	18	3 50 per day	63 00	5 97	68 97
John Hickey	Rodman	18	3 50 per day	63 00	8 58	71 58
T. V. Owens	Chainman	41	2 50 per day	102 50	20 90	123 40
M. J. Rosa	Chainman	44	2 50 per day	110 00	3 55	113 55
						$602 47
Incidental expenses.						
Postage and telegraph					$0 35	
Miscellaneous					97 23	
						97 58
Total clearing reservoir, Forestport dam, chap. 342, Laws of 1891						$700 05

BASIN AT HAVANA AND OPENING SENECA LAKE LEVEL — CHEMUNG CANAL.

Chapters 416 *and* 568, *Laws of* 1888 *and* 1889.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
H. T. Beach	Division engineer	2	$2,400 00 per annum	$13 15	$8 00	$21 15
D. E. Whitford	Resident engineer	39	2,000 00 per annum	213 70	21 29	234 99
A. C. Driscoll	Leveler	7	4 50 per day	31 50	13 08	44 58
N. E. Whitford	Rodman	9	3 50 per day	31 50	15 98	47 48
T. V. Owens	Chainman	5	2 50 per day	12 50	12 37	24 87
						$372 97
Incidental expenses.						
Labor					$3 00	
Miscellaneous					2 75	
						5 75
Total Havana basin, etc., chaps. 416 and 568, Laws of 1888 and 1889						$378 72

SURVEYS STATE BOARD OF CLAIMS — CHEMUNG CANAL.

Chapter 302, *Laws of* 1891.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
H. T. Beach	Division engineer	....	$2,400 00 per annum	$6 57	$5 24	$11 81
Charles G. Witbeck	Assistant engineer in charge	16	6 00 per day	96 00	30 62	126 62
A. C. Driscoll	Leveler	5	4 50 per day	22 50	14 66	37 16
Theo. A. Hendrickson	Rodman	4	3 50 per day	14 00	9 46	23 46
E. J. Waldron	Chainman	3	2 50 per day	7 50	9 46	16 96
						$216 01
	Incidental expenses.					
Miscellaneous					$0 50	50
Total surveys, etc., Chemung canal, chap. 302, Laws of 1891						$216 51

IMPROVING HARBOR AT FOOT OF CANANDAIGUA LAKE.

Chapter 204, *Laws of* 1889.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary	Travel.	Total
D. E. Whitford	Resident engineer	10	$2,000 per annum	$54 79	$6 03	$60 82
	Incidental expenses.					
Miscellaneous						1 35
Total improving harbor, etc., chap. 204, Laws of 1889						$62 17

SUMMARY.

ITEMS.	Authorized by Chap.	Authorized by Year.	Amounts.	Totals.
ORDINARY REPAIRS.	296	1890	....	
Erie canal	......	......	$6,612 55	
Oswego canal	......	......	2,097 60	
Cayuga and Seneca canal	......	......	645 29	
Black River canal	......	......	1,255 61	
Total ordinary repairs	......	......	$10,611 05	$10,611 05
EXTRAORDINARY REPAIRS.				
Erie Canal.				
Stone culvert over old Erie canal, Rome	81	1890	$38 31	
Lengthening locks	168	1890	3,102 52	
Bottoming out Erie canal	168	1890	313 16	
Surveys State Board of Claims	295	1890	372 58	
Improving sanitary condition old Erie canal, Rome	385	1890	99 45	
Swing or lift bridge at Schuyler street, Utica	69	1891	111 62	
Surveys State Board of Claims	302	1891	392 78	
Total Erie canal	......	......	$4,430 42	4,430 42
Oswego Canal.				
Lengthening locks	168	1890	$5,201 36	
Surveys State Board Claims	295	1890	280 30	
Total Oswego canal	......	......	$5,481 66	5,481 66
Black River Canal.				
Dam at head of Forestport pond	274	1889	$1,940 38	
Partial rebuilding lock No. 1	168	1890	1,304 44	
Surveys State Board of Claims Flow line Beaver river reservoir	295	1890	487 42	
Surveys State Board of Claims Flow line Beaver river reservoir	302	1891	129 23	
Clearing reservoir Forestport dam	342	1891	700 05	
Total Black River canal	......	......	$4,561 52	4,561 52
Chemung Canal.				
Basin at Havana and opening Seneca lake level	416 568	1889 1889	$378 72	
Surveys State Board of Claims	302	1891	216 51	
Total Chemung canal	.....	......	$595 23	595 23
Miscellaneous.				
Improving harbor at foot of Canandaigua lake	204	1889	$62 17	$62 17
Total engineering, etc., for fiscal year ending September 30, 1891				$25,742 05

TABLE No. 2.

Statement of work under contract upon the middle division of the New York State canals for the fiscal year ending September 30, 1891.

ERIE CANAL.

CHARACTER OF WORK.	AUTHORIZED BY		Appropriations.	WHEN LET.		WHEN TO BE COMPLETED.	
	Chapter	Laws of		Date.	Year.	Date.	Year.
Stone culvert over Old Erie canal, Rome	81	1890	$1,500 00	July 1	1890	Aug. 15	1890
Lengthening tow-path lock No 46 and replacing old superstructure at Schuyler street, Utica	168	1890	Part of 185,000 00	July 8	1890	April 15	1891
Substructure for swing-bridge near Schuyler street, Utica	69	1891	Part of 5,250 00	Aug. 19	1891	Feb. 1	1892
Superstructure for swing-bridge near Schuyler street, Utica	69	1891	Part of 5,250 00	Aug. 19	1891	April 1	1892
Sidewalks on Depuyster street bridge, Rome	241	1891	1,000 00	July 27	1891	Oct. 1	1891
OSWEGO CANAL.							
Oneida river improvement	568	1889	10,000 00	Jan. 14	1890	April 20	1890
Lengthening lock No. 8 at the foot	168	1890	Part of 70,000 00	July 8	1890	April 15	1891
Lengthening lock No. 12 at the head	168	1890	Part of 70,000 00	July 8	1890	April 15	1891
BLACK RIVER CANAL.							
Reservoir dam above Forestport pond	274	1887	45,000 00	Aug. 8	1889	Oct. 15	1889
Rebuilding a portion of lock No. 1	168 143	1890 1891	10,000 00 5,000 00	July 8	1890	April 15	1891
CHEMUNG CANAL.							
Substructure for swing-bridge at Watkins	416	1888	Part of 20,000 00	Mar. 18	1889	July 1	1889
Havana basin, etc	416 568	1888 1889	Part of 20,000 00 5,000 00	Sept. 3	1889	April 20	1890
CANANDAIGUA LAKE.							
Deepening harbor and constructing break-water	204	1889	21,000 00	Aug 30	1889	Jan. 1	1890

TABLE NO. 2 — *Statement of work under contract upon the middle division, etc.* — (Concluded) — ERIE CANAL.

CHARACTER OF WORK.	Engineer's estimate exclusive of engineering.	Estimated cost at contract prices.	Amount done during fiscal year.	Total amount done.	Remarks.
Stone culvert over Old Erie canal, Rome	$1,260 00	$1,204 90	$491 40	$971 40	Work stopped; final rendered.
Lengthening tow-path lock No. 46 and replacing old superstructure at Schuyler street, Utica	24,318 75	22,390 25	25,984 42	25,984 42	Final rendered.
Substructure for swing-bridge near Schuyler street, Utica	2,352 60	2,572 75	....	....	In progress.
Superstructure for swing-bridge near Schuyler street, Utica	2,000 00	1,900 00	....	....	In progress.
Sidewalks on Depuyster street bridge, Rome	864 50	850 00	....	....	In progress.
OSWEGO CANAL.					
Oneida river improvement	8,460 60	8,050 00	1,592 13	9,072 13	Final rendered.
Lengthening lock No. 8 at the foot	29,916 70	31,731 70	29,193 39	34,493 39	Final rendered.
Lengthening lock No. 12 at the head	34,274 20	37,245 70	34,593 16	38,983 16	Final rendered.
BLACK RIVER CANAL.					
Reservoir dam above Forestport pond	64,635 00	44,847 50	13,900 00	39,500 00	Completed to the extent of appropriation.
Rebuilding a portion of lock No. 1	7,683 00	7,881 00	12,120 35	12,120 35	Final rendered.
CHEMUNG CANAL.					
Substructure for swing-bridge at Watkins	3,777 50	4,276 00	111 58	5,851 58	Final rendered.
Havana basin, etc	10,900 00	10,298 00	2,150 62	10,830 62	Completed to the extent of the appropriation; final rendered.
CANANDAIGUA LAKE.					
Deepening harbor and constructing break-water	19,050 00	18,878 00	112 88	18,472 88	Final rendered.

TABLE No. 3.

Water record of Cayuga and Cross lakes and Seneca river, as per concurrent resolution of 1884.

(Water surface given below datum line.)

LOCATION.	Bench-mark number.	Miles from Cayuga lock.	1884.				1885.					
			AUGUST 5, 6 AND 7.		DECEMBER 2, 3 AND 4.		MARCH 4, 5, 6 AND 7.		AUGUST 6 AND 7.		DECEMBER 2, 3 AND 4.	
			WATER.		WATER.		WATER.		WATER.		WATER.	
			Surface.	Depth.	Surface.	Depth.	Surface.	Depth.	Surface.	Depth.	Surface.	Depth.
Cayuga lake	1	0	— 8.59	10.49	—10.11	8.97	—10.00	9.08	— 9.83	9.75	— 8.78	10.30
Mud lock	2	1½	— 8.80	10.42	—10.22	9.00	—10.17	9.05	— 9.54	9.68	— 8.91	10.31
Canandaigua river, south of canal	....	6½	—11.20	5.60	—12.68	4.00	—12.54	4.60	—11.93	5.20	—11.09	6.10
Aqueduct	3	6½	—11.42	7.03	—12.98	5.47	—12.66	5.70	—12.19	6.20	—11.26	7.10
Canandaigua river, north of canal	....	6½	—11.58	5.40	—13.01	4.00	—12.83	4.90	—12.48	5.20	—11.46	6.20
West Shore railroad crossing	4	9	—11.85	3.75	—13.20	2.40	—12.70	2.80	—12.87	2.60	—11.48	3.60
			....	7.80	....	6.50	....	7.70	....	7.50	....	8 50
N. Y. C. and H. R. R. R. crossing	5	10	—12.41	4.80	—14.19	3.00	—13.48	3.90	—13.48	3.90	—12.66	4.70
Mosquito Point	6	15¼	—15.92	0.10	—16.81	*	—16.70	*	—16.04	*	—14.23	1.80
			....	7.20	....	6.90	....	6.40	.. ..	7.10	....	8.90
Cross lake	7	25	—17.32	19.20	—17.55	19.00	—18.00	18.50	—17.85	13.70	—15.88	21.10

* Above water.

TABLE No. 3 — *Water record of Cayuga and Cross lakes and Seneca river, etc.* — (Continued).

LOCATION.	1886.						1887.						1888.					
	MARCH 8 AND 9.		AUGUST 5, 6 AND 7.		DECEMBER 7.		MARCH 4.		AUGUST 5.		DECEMBER 2		MARCH 2.		AUGUST 6.		DECEMBER 3 AND 4.	
	WATER.		WATER.		WATER.		WATER.		WATER.		WATER.		WATER.		WATER.		WATER.	
	Surface.	Depth	Surface.	Depth.	Surface.	Depth.	Surface.	Depth.	Surface	Depth.	Surface.	Depth.	Surface.	Depth.	Surface.	Depth.	Surface.	Depth.
Cayuga lake	— 8.11	10.97	— 8.49	10.59	— 8.33	10.75	— 6.82	12.39	— 8.22	10.86	— 9.75	9.33	— 9.00	10.08	— 8.88	10.20	— 9.28	9.80
Mud lock	— 8.26	10.96	— 8.76	10.46	— 8.46	10.76	— 6.82	12.40	— 8.35	10.87	— 9.97	9.25	— 9.11	10.11	— 9.09	10.18	— 9.48	9.74
Canandaigua river, south of canal	— 9.61	7.60	—11.88	5.40	—10.20	7.00	— 7.89	9.30	—10.87	6.30	......	....	—10.14	7.00	—11.42	5.7	—10.66	6.5
Aqueduct	— 9.72	8.70	—12.12	6.30	—10.35	8.10	— 8.14	10.30	—11.09	7.30	—12.42	6.00	—10.26	8.1	—11.63	6.8	—10.84	7.6
Canandaigua river, north of canal	— 9.93	7.80	—12.24	5.40	—10.59	7.10	— 8.30	9.40	—11.51	6.20	—12.64	5.1	—10.57	7.2	—11.98	5.7	—11.12	6.6
W. S. R. R. crossing	—10.24	5.20	—12.76	2.70	—10.79	4.50	— 8.82	6.70	—12.00	3.50	—12.91	2.6	—10.95	4.5	—12.20	3.2	—11.35	4.1
	......	10.50	......	7.60	......	9.40	......	11.60	......	8.40	......	7.5	......	9.4	......	8.1	......	9.0
N. Y. C. and H. R. R. R. crossing	—10.74	6.60	—13.31	4.00	—11.61	5.70	— 9.18	8.10	—12.55	4.80	—13.67	8.7	—11.45	5.9	—53.00	4.4	—12.19	5.2
Mosquito Point	—12.15	4.00	—16.26	*	—18.39	2.60	—10.52	5.50	—15.41	0.60	—16.57	*	—13.22	2.8	—15.63	0.4	—14.69	1.3
	......	11.00	......	7.00	......	9.70	......	12.60	......	7.70	......	6.5	......	9.9	......	7.5	......	8.4
Cross lake	—14.01	52.50	—17.71	18.80	—15.39	21.10	—12.09	24.40	—17.17	19.80	—17.42	19.1	—14.58	2.2	—17.40	19.1	—14.83	21.67

* Above water.

TABLE No. 3 — *Water record of Cayuga and Cross lakes and Seneca river, etc.*— (Continued).

LOCATION.	1889.						1890.					
	MARCH 5 AND 6.		AUGUST 5.		DEC. 4 AND 5.		MARCH 6 AND 7.		AUGUST 8.		DECEMBER.	
	WATER.		WATER.		WATER.		WATER.		WATER.		WATER.	
	Surface.	Depth.	Surface.	Depth.	Surface.	Depth.	Surface.	Depth.	Surface.	Depth.	Surface.	Depth.
Cayuga lake	— 8.93	10.15	— 6.92	12.16	— 6.56	12.52	— 7.41	11.67	— 7.47	11.61	— 7.46	11.62
Mud lock	— 9.04	10.18	— 7.00	12.22	— 6.96	12.26	— 7.55	11.67	— 7.67	11.55	— 7.60	11.62
Canandaigua river, south of canal	— 9.88	7.26	— 8.82	8.8	— 8.29	8.8	— 8.92	8.2	—10.51	6.6	— 9.46	7.7
Aqueduct	—10.07	8.29	— 9.03	9.4	— 8.56	9.9	— 9.23	9.2	—10.78	7.6	— 9.79	8.6
Canandaigua river, north of canal	—10.28	7.74	— 9.88	8.4	— 8.73	9.0	— 9.27	8.4	—11.28	6.5	— 9.98	7.7
West Shore railroad crossing	—10.47	5.0	— 9.84	5.7	— 8.74	6.8	— 9.75	5.8	—11.50	4.0	—10.34	5.2
	....	9.9	....	10.6	....	11.7	....	10.7	....	8.9	....	10.1
N. Y. C. and H. R. R. R. crossing	—10.97	6.4	—10.47	7.0	— 9.17	8.2	— 9.78	7.6	—12.31	5.1	—10.61	6.8
Mosquito point	—12.25	8.8	—12.92	8.1	—10.59	5.4	—10.91	5.1	—15.16	0.8	—11.83	4.7
	....	10.9	....	10.2	....	12.5	....	12.2	....	7.9	....	11.8
Cross lake	—14.13	22.4	—13.32	23.2	—11.75	24.8	—12.95	23.6	—16.23	20.3	—13.87	23.1

TABLE NO. 3 — *Water record of Cayuga and Cross lakes and Seneca river, etc.*— (Concluded).

LOCATION.	1891.				Remarks.
	MARCH 3 AND 6.		AUGUST.		
	WATER.		WATER.		
	Surface.	Depth.	Surface.	Depth.	
Cayuga lake	— 5.89	13.19	— 8.96	10.12	Depth on lock miter-sill.
Mud lock	— 5.96	13.26	— 9.27	9.95	Depth of miter-sill.
Canandaigua river, south of canal	— 7.16	10.0	—12.69	4.4	Depth of river.
Aqueduct	— 7.48	10.9	—12.71	5.7	Depth on aqueduct foundation.
Canandaigua river, north of canal	— 7.45	10.2	—12.97	4.7	Depth of river.
West Shore railroad crossing	— 7.65	6.0	—13.29	2.3	Depth on natural bed.
	....	12.8	....	7.1	Depth in channel dredged.
New York Central and Hudson River railroad crossing	— 7.84	7 9	—13.92	3.5	Depth on bridge foundation.
Mosquito point	— 8.64	7.4	—16.70	Bed dry	Depth on natural bed.
	....	14.5	....	6.4	Depth in channel dredged.
Cross lake	—10.4	26.0	—17.48	19.0	Depth at iron bridge.

TABLE

Showing the location of the structures on the Erie canal, from the east line between them,

[N. B.- Numbers omitted represent

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			FRANKFORT LEVEL, $3\frac{356}{1000}$ MILES.
......	0.00	0.00	East line of Oneida county
1	0.04	3.13	Greene's road bridge (Cooper)
C. 1	.....	44.72	Stone culvert, three arches
2	0.70	8.01	Starch factory bridge
......	.....	.....	Railroad swing-bridge (Hatfield switch)
C. 2	....	39.94	Stone culvert, three-feet arch
......	.....	.....	Mohawk cotton factory bridge (private)
3	1.58	30.55	Clay street bridge, Utica
B. H. 1	.....	26.75	Ballou creek bulkhead and waste-weir
4	2.06	11.32	Broad street bridge, Utica (Whipple arch)
5	.....	7.45	Catharine street bridge, Utica (Swartz suspension)
......	.....	.....	Pipe culvert (city)
6	.....	9.23	First street bridge, Utica (Whipple arch)
7	2.37	8.30	John street lift-bridge, Utica
......	.....	1.83	Weigh-lock building
8	2.50	8.81	Genesee street bridge, Utica (Whipple arch)
9	.....	3.10	Hotel street lift-bridge, Utica
10	.....	3.26	Seneca street bridge, Utica (Whipple arch)
11	.....	5.17	Washington street bridge, Utica
12	.....	4.74	Broadway foot-bridge, Utica
13	.....	10.97	Cornelia street foot-bridge, Utica (iron chord)
......	.....	.....	Pipe culvert at State street, Utica (city)
......	.....	.....	Chenango canal junction
14	3.00	12.62	Whitesboro street bridge, Utica
......	.....	3.25	Midland railroad swing-bridge, Utica (lattice)
15	.....	8.49	Breese street foot-bridge, Utica
C. 3	.....	10.57	Stone arch culvert at Nail creek, ten-feet chord
......	.....	.....	Pipe culvert, four feet diameter (city)
......	.....	4.75	Del., Lack. and Western Railroad swing-bridge, Utica (plate girder)
......	3.36	1.52	Foot of lock No. 46
			ROME LEVEL $55\frac{957}{1000}$ MILES.
			Lock No. 46, three-feet lift, westward.
16	.....	2.17	Schuyler street bridge, Utica (Whipple arch)

No. 4.

of Oneida county to the south line of Wayne county, with the distances as follows:

structures abandoned.]

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$71\frac{4}{12}$	1	$17\frac{11}{12}$	....	......	....	1881
......	.....	......	....	......	....	......	....	1891
......	Wood	$80\frac{10}{12}$	2	13	....	......	19° 10′ R	1884
......	Iron .	......	....	......	....	......	....	1890
......	.....	......	....	......	....	......	....	....
......	Iron .	84	....	......	1	7	....	....
......	Iron .	$72\frac{8}{12}$	1	$14\frac{4}{12}$	....	......	30° R	1879
......	.....	......	....	......	....	......	....	1879
Iron ..	.....	$91\frac{1}{12}$	2	$15\frac{6}{12}$	2	$7\frac{7}{12}$	33° 20′ L	1889
Iron ..	.....	$72\frac{10}{12}$	1	$18\frac{9}{12}$	2	$7\frac{6}{12}$	....	1885
.....	.....	......	....	......	....	......	....	....
Iron ..	.....	$77\frac{11}{12}$	1	$17\frac{6}{12}$	....	......	....	1881
......	Iron .	$74\frac{8}{12}$	1	24	2	$5\frac{6}{12}$	3° 55′ R	1888
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$82\frac{1}{12}$	2	$18\frac{10}{12}$	2	$17\frac{10}{12}$ $17\frac{7}{12}$	28°15′R	1890
......	Iron .	72	1	$19\frac{6}{12}$	1	$3\frac{7}{12}$	....	1884
Iron ..	.....	$72\frac{6}{12}$	1	$19\frac{6}{12}$	2	$7\frac{6}{12}$	3° 20′ R	1879
Iron ..	.....	$73\frac{1}{12}$	1	$18\frac{6}{12}$	2	$6\frac{6}{12}$ 7	3° 40′ R	1879
......	Iron .	$70\frac{6}{12}$	....	......	1	$8\frac{4}{12}$	9° 10′ R	1870
......	Wood	$72\frac{4}{12}$	....	......	1	9	....	1882
.....	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Iron .	$88\frac{8}{12}$	2	$16\frac{6}{12}$	2	$8\frac{10}{12}$	33° 40′ R	1890
......	Iron .	$63\frac{9}{12}$	1	$14\frac{3}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	Down
......	.....	......	....	......	....	......	....	1882
......	.....	......	....	......	....	......	....	....
......	Iron .	$89\frac{4}{12}$	1	14	....	......	....	1889
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$79\frac{2}{12}$	1	16	2	$6\frac{6}{12}$ 6	0° 37′ R	....

TABLE No. 4—(Continued)—*Showing the location*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			ROME LEVEL — (*Continued*).
17	3.70	25.15	Platt street foot-bridge, Utica ....
C. 4	.....	58.34	Composite culvert, 2x2 feet...............
19	4.64	16.81	Whitesboro road-bridge (Bollman) ....
C. 5	.....	2.20	Box culvert, 2x2 feet ....
C. 6	.....	25.48	Composite drop culvert, 3x3 feet ....
20	5.36	29.91	Yorkville road-bridge (riveted) ....
C. 7	.....	8.04	Double arch culvert, ten-feet chord ....
A. 1	.....	15.88	Sauquoit creek aqueduct, three spans, twenty-two feet each, stone abutments and pier.............................
21	6.12	37.52	Clinton street bridge, Whitesboro (Whipple arch) ....
......	.....	.....	Babbit's foot-bridge ....
22	.....	26.00	Westmoreland street bridge (Whipple arch)
23	.....	7.25	Suspension foot-bridge..................
C. 8	.....	14.67	Composite drop culvert, two openings, 2x2½ feet each............................
24	6.84	9.45	Watkins street bridge ....
C. 9	.....	14.03	Composite drop culvert, 2½x2½ feet ....
C. 10	.....	19.50	Composite drop culvert, 2x2 feet ....
25	7.63	29.22	Bradley road-bridge (Whipple arch).......
26	8.78	92.07	Evens' farm bridge ....
27	9.19	32.74	Christman's farm bridge ....
......	.....	1.40	Oriskany feeder. The dam and bulkhead of this feeder is located $46\frac{60}{100}$ chains south of canal ....
A. 2	.....	10.63	Oriskany aqueduct, four spans, twenty-two feet each, stone abutments and piers.....
28	9.51	13.82	River street bridge, Oriskany (Whipple arch)
C. 11	.....	6.62	Arch culvert, twelve feet chord ....
29	10.36	61.33	Brainard's farm bridge..................
30	.....	21.33	Parkhurst's farm bridge (iron chords)......
31	11.11	38.89	Kirley's farm bridge (iron chords).........
C. 12	.....	21.03	Composite culvert, three openings, 3x2½ feet each ....
32	12.34	76.96	Murphy's road-bridge ....
B. H. 2	13.51	93.66	Bulkhead and waste-weir and spillway .....
33	.....	10.66	Clark's farm bridge......................
34	15.63	159.43	Stanwix road-bridge (Whipple arch).......
C. 13	.....	25.31	Whitehall composite culvert, four openings, 3x4 feet............................
34½	.....	65	Road-bridge on berme side ....
35	16.03	5.37	Greenfield road-bridge (Whipple arch).....
35¼	.....	40.28	Towpath bridge (stringer) over old feeder ..

the structures on the Erie canal, feeders and reservoirs.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	Iron..	$115\frac{4}{12}$	....	......	1	12	....	1886
......	.....	......	....	......	....	......	....	.....
......	Iron..	$71\frac{4}{12}$	2	$15\frac{1}{12}$	....	......	....	1885
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	Iron..	$79\frac{5}{12}$	1	$21\frac{7}{12}$	2	$7\frac{6}{12}$	22° 55′ R	1889
......	.....	......	....	......	....	......	....	.....
......	.....	......	...	......	....	......	....	1891
Iron ..	.....	$79\frac{7}{12}$	1	19	1	$4\frac{7}{12}$	26° 10′ L	1886
......	Iron..	$88\frac{4}{12}$	....	......	1	$6\frac{4}{12}$	....	.....
Iron ..	.....	$80\frac{2}{12}$	1	$18\frac{3}{12}$	2	$5\frac{4}{12}$	3° 55′ R	.....
......	Iron..	$104\frac{8}{12}$	....	.....	1	6	....	.....
......	.....	......	....	......	....	......	....	.....
......	Wood	$71\frac{10}{12}$	1	13'	....	......	1° 25′ R	1881
......	.....	......	....	......	...	......	....	.....
......	.....	......	....	......	....	......	....	.....
Iron ..	.....	$71\frac{1}{12}$	1	$17\frac{11}{12}$	....	......	....	1890
......	Wood	$71\frac{1}{12}$	1	13	...	......	....	1884
......	Wood	$70\frac{4}{12}$	1	13	....	......	....	1890
......	.....	......	....	......	...	......	....	1883
......	.....	......	....	......	....	......	....	.....
Iron ..	.....	80	1	$18\frac{1}{12}$	2	$5\frac{7}{12}$	22° 50′ L	1881
......	.....	......	....	......	....	......	....	.....
......	Wood	$72\frac{2}{12}$	1	13	....	......	....	1886
.....	Wood	71	1	$12\frac{10}{12}$	....	......	....	1885
......	Wood	71	1	$12\frac{10}{12}$	....	......	....	1881
.....	....	......	....	......	....	......	....	1885
......	Wood	$72\frac{3}{12}$	1	13	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	Wood	$71\frac{8}{12}$	1	$13\frac{2}{12}$	....	......	....	1884
Iron ..	.....	$80\frac{4}{12}$	1	$19\frac{6}{12}$	2	$6\frac{5}{12}$	27° 10′ L	1881
......	.....	......	....	......	....	......	....	1878
......	Wood	$40\frac{8}{12}$	1	$14\frac{4}{12}$	....	......	....	1890
Iron ..	.....	$71\frac{10}{12}$	1	$14\frac{1}{12}$	....	......	....	.....
......	Wood	22	1	$15\frac{3}{12}$	....	......	....	1883

TABLE No. 4—(Continued)—*Showing the location of*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			ROME LEVEL—(*Continued*).
35½	.....	45.24	Stone arch bridge—Mohawk feeder. The dam is located 7$\frac{60}{100}$ chains below feeder, north of canal
35¾	.....	.....	Towpath bridge (stringer) over feeder
36	17.12	2.20	DePuyster street bridge, Rome (Whipple arch
......	.....	10.86	N. Y. C. and H. R. R. R. bridge (lattice)
......	.....	0.44	N. Y. C. and H. R. R. R. bridge (Howe)
36½	.....	1.50	Tubular towpath bridge, Rome
37	17.35	5.84	James street bridge, Rome (Whipple arch).
38	.....	10.27	Washington street bridge, Rome (Whipple arch)
39	.....	10.85	George street bridge, Rome, (Whipple arch)
40	17.89	21.40	Jay street bridge, Rome (Bollman)
40½	.....	14.00	Towpath bridge over Wood creek (stringer)
41	.....	1.04	Private foot bridge
42	18.41	26.79	Doxtator avenue bridge (iron chords)
......	.....	20.99	Rome, Watertown and Ogdensburgh railroad bridge (pin connected)
43	.....	6.31	Barnes' farm bridge
C. 14	.....	77.33	Composite culvert
44	19.92	15.96	Brainard's farm bridge
B. H. 3	.....	24.89	Fort Bull bulkhead and waste-weir and spillway (stone)
C. 15	.....	15.29	Arch culvert, four-feet chord
C. 16	.....	81.49	Arch culvert, four-feet chord
45	21.66	17.96	Armstrong's farm bridge
C. 17	.....	21.65	Composite culvert
46	22.21	30.16	Herrig's road bridge
C. 18	.....	35.47	Arch culvert, twelve-feet chord
47	23.10	27.94	Sand's farm bridge
C. 19	.....	31.17	Arch culvert, four-feet chord
48	22.93	35.23	Tuttle's road bridge (iron chords)
C. 20	.....	16.80	Composite culvert, four-feet opening
49	24.47	26.19	Main street, New London (Whipple arch)
C. 21	.....	37.76	Composite culvert, four-feet opening
C. 22	.....	30.90	Composite culvert, four-feet opening
C. 23	.....	24.67	Composite culvert, 4x4 feet opening
51	25.78	11.39	Grove Spring road bridge
52	.....	9.26	Private foot-bridge (suspension)
C. 24	.....	23 17	Composite culvert, 2x4 feet openings
53	26.43	19.74	Stacey's basin, road bridge
54	.....	14.16	Private foot-bridge (suspension)
C. 25	.....	8.69	Composite culvert, three openings

the structures on the Erie canal, feeders and reservoirs.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	....	......	....	......	....	.....
......	Wood	......	1	......	....	......	....	.....
Iron. .	.....	$82\frac{4}{12}$	1	$16\frac{8}{12}$	....	......	....	1880
......	Iron..	$89\frac{6}{12}$	2	$15\frac{1}{12}$	....	......	....	1872
......	Iron . .	$89\frac{6}{12}$	2	28	....	......	....	1888
Iron ..	.....	$71\frac{11}{12}$	1	$12\frac{6}{12}$	....	......	....	.....
Iron ..	.....	$92\frac{1}{12}$	2	19	2	$8\frac{2}{12}$ $8\frac{6}{12}$	......	1885
Iron ..	......	$78\frac{1}{12}$	2	$18\frac{6}{12}$ 18	2	$5\frac{7}{12}$	7° 30′ L	1890
Iron ..	.....	$71\frac{11}{12}$	1	$16\frac{6}{12}$	....	......	2° 50′ R	1870
......	Iron..	78	1	$18\frac{6}{12}$	2	$5\frac{5}{12}$	13° 40′ R	1889
......	.....	$30\frac{1}{12}$	1	$13\frac{3}{12}$	....	......	....	1885
......	Wood	$87\frac{2}{12}$	....	......	1	$6\frac{9}{12}$	....	....
......	Wood	$111\frac{8}{12}$	1	$17\frac{11}{12}$	....	......	....	....
......	Iron..	$120\frac{4}{12}$	1	$15\frac{5}{12}$	...	......	....	1876
......	Wood	$71\frac{3}{12}$	1	13	....	......	....	1885
......	.....	......	....	......	....	......	....	....
......	Wood	$70\frac{10}{12}$	1	13	....	......	....	1886
......	.....	......	....	......	....	......	....	1891
......	.....	......	....	......	....	......	....	...
......	.....	......	....	......	....	......	....	....
......	Wood	$71\frac{4}{12}$	1	13	....	......	....	1886
......	.....	......	....	......	....	......	....	....
......	Wood	$72\frac{3}{12}$	1	$13\frac{1}{12}$	...	......	....	1885
......	.....	......	....	......	....	......	....	....
......	Wood	$71\frac{10}{12}$	1	13	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$71\frac{5}{12}$	1	$13\frac{3}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....
Iron ..	.....	89	1	$19\frac{3}{12}$	2	6	11° 00′ L	1885
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$78\frac{1}{12}$	1	13	....	......	....	1890
......	Iron..	$88\frac{10}{12}$	....	......	1	$5\frac{9}{12}$	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$74\frac{4}{12}$	1	13	....	......	14° 40′ L	1886
......	Iron .	$89\frac{6}{12}$	....	......	1	$5\frac{7}{12}$	....	....
......	.....	......	....	......	....	......	....	....

TABLE No. 4—(Continued—*Showing the location of*

Number of structure.	Cumulative distance in miles.	Distance in chains and links.	GENERAL DESCRIPTION.
			ROME LEVEL—(*Continued*).
55	27.23	41.57	Happy Valley road bridge ....
C. 26	.....	27.55	Composite culvert, three openings..........
B. H. 4	.....	0.75	Waste-weir, bulkhead and spillway on berme side ....
56	.....	47.04	Swing-bridge over old Oneida Lake canal ..
57	28.24	5.14	Higginsville east road bridge ....
C. 27	.....	27.58	Composite culvert, three-feet openings.....
58	28.64	4.73	Higginsville west road bridge (Whipple arch)
C. 28	.....	21.18	Composite culvert, four feet openings......
C. 29	.....	32.05	Composite culvert, four-feet openings......
59	29.54	18.63	Dunbarton road bridge..................
C. 30	.....	12.88	Composite culvert, four-feet openings......
C. 31	.....	26.86	Composite culvert, three-feet openings.....
60	30.17	10.95	Durkee road bridge ....
C. 32	.....	39.66	Composite culvert, one opening ....
61	30.76	7.58	State road bridge.......................
C. 33	.....	27.36	Composite culvert, two openings, three feet each ....
.....	.....	3.34	Midland railroad bridge, lattice ....
C. 34	.....	53.89	Arch culvert, four-feet chord ....
C. 35	.....	9.67	Arch culvert, four-feet chord ....
C. 36	32.24	23.81	Brandy brook arch culvert, twelve-feet chord
62	.....	16.82	Private suspension foot-bridge ....
63	32.77	26.06	Durhamville east road bridge (Whipple arch)
C. 37	.....	4.76	Arch culvert four-feet chord......... ..
64	32.94	8.13	Main street bridge, Durhamville (Whipple arch) ....
C. 38	.....	7.69	Arch culvert, two spans, each twenty-five feet chord............................
B. H. 5	.....	.....	Bulkhead and waste-weir directly over the end of arch culvert....................
65	.....	6.47	Bennett's road bridge (iron chords)........
......	.....	4.70	Oneida creek feeder. The dam and bulkhead of this feeder are located 232$\frac{46}{100}$ chains south of the canal................
65½	.....	2.00	Bridge over new Oneida Lake canal (stringer)
66	34.14	75.15	Shoolhammer's road bridge (iron chords). The north approach of this bridge is a wooden truss over highway.............
A. 3	34.59	46.51	Cowassalon aqueduct, two spans, twenty feet each................................
......	.....	9.00	Cowassalon feeder. The dam and bulkhead of this feeder are located 31 chains south of canal ....

the structures on the Erie canal, feeders and reservoirs.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	Wood	$70\frac{10}{12}$	1	13	....	......	1° 00′ L	1890
....	.....	......	....	......	....	......	....	...
......	.....	......	....	......	....	......	....	....
......	Wood	$20\frac{7}{12}$	1	$16\frac{2}{12}$	....	......	....	1888
......	Wood	$73\frac{1}{12}$	1	$16\frac{9}{12}$	....	......	8° 50′ R	....
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$71\frac{7}{12}$	1	$17\frac{9}{12}$	....	......	....	1879
......	.....	.....	...	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$71\frac{3}{12}$	1	$17\frac{10}{12}$	....	......	....	1883
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$71\frac{7}{12}$	1	16	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$71\frac{8}{12}$	1	$18\frac{2}{12}$	....	......	....	1883
......	.....	......	....	......	....	......	....	....
......	Iron .	$125\frac{10}{12}$	1	......	....	......	....	1890
......	.....	......	...	......	...	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	...	......	....	......	....	....
......	Iron .	$90\frac{6}{12}$	....	......	1	$6\frac{1}{12}$	....	....
Iron ..	.....	$71\frac{9}{12}$	1	$18\frac{10}{12}$	1	$6\frac{6}{10}$	....	1888
......	.....	......	....	.....	....	......	....	....
Iron ..	.....	$71\frac{9}{12}$	1	19	2	$5\frac{10}{12}$	....	1886
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1891
......	Wood	$71\frac{9}{12}$	1	$17\frac{2}{12}$	....	......	1° 05′ R	1885
......	.....	......	....	......	....	......	....	....
......	Wood	20	1	$17\frac{5}{12}$	....	......	....	....
......	Wood	$74\frac{9}{12}$	1	$17\frac{2}{12}$	....	......	2° 30′ R	1881
......	.....	......	....	......	....	......	....	1891
......	.....	......	....	......	....	......	....	....

TABLE No. 4—(Continued)—*Showing the location of*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			ROME LEVEL—(*Continued*).
55	27.23	41.37	Happy Valley road bridge ....
C. 26	.....	27.35	Composite culvert, three openings.........
B. H. 4	.....	0.75	Waste-weir, bulkhead and spillway on berme side ....
56	.....	47.04	Swing-bridge over old Oneida Lake canal ..
57	28 24	5.14	Higginsville east road bridge ....
C. 27	.....	27.58	Composite culvert, three-feet openings.....
58	28.64	4.73	Higginsville west road bridge (Whipple arch)
C. 28	.....	21.18	Composite culvert, four-feet openings......
C. 29	.....	32.05	Composite culvert, four-feet openings......
59	29.54	18.63	Dunbarton road bridge..................
C. 30	.....	12.88	Composite culvert, four-feet openings......
C. 31	.....	26.86	Composite culvert, three-feet openings.....
60	30.17	10.93	Durkee road bridge ....
C. 32	.....	39.66	Composite culvert, one opening ....
61	30.76	7.58	State road bridge.......................
C. 33	.....	27.36	Composite culvert, two openings, three feet each ....
.....	.....	3.34	Midland railroad bridge, lattice ....
C. 34	.....	53.89	Arch culvert, four-feet chord ....
C. 35	.....	9.67	Arch culvert, four-feet chord ....
C. 36	32.24	23.81	Brandy brook arch culvert, twelve-feet chord
62	.....	16.82	Private suspension foot-bridge ....
63	32.77	26.06	Durhamville east road bridge (Whipple arch)
C. 37	.....	4.76	Arch culvert four-feet chord........... ..
64	32.94	8.13	Main street bridge, Durhamville (Whipple arch) ....
C. 38	.....	7.69	Arch culvert, two spans, each twenty-five feet chord............................
B. H. 5	.....	.....	Bulkhead and waste-weir directly over the end of arch culvert..................
65	.....	6.47	Bennett's road bridge (iron chords)........
......	.....	4.70	Oneida creek feeder. The dam and bulkhead of this feeder are located $232\frac{40}{100}$ chains south of the canal...............
65½	.....	2.00	Bridge over new Oneida Lake canal (stringer)
66	34.14	75.15	Shollhammer's road bridge (iron chords). The north approach of this bridge is a wooden truss over highway............
A. 3	34.59	46.51	Cowassalon aqueduct, two spans, twenty feet each.............................
......	.....	9.00	Cowassalon feeder. The dam and bulkhead of this feeder are located 31 chains south of canal..........................

the structures on the Erie canal, feeders and reservoirs.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	Wood	$70\frac{10}{12}$	1	13	....	......	1° 00′ L	1890
....	.....	......	....	......	....	......	....	...
......	.....	......	....	......	....	......	....	....
......	Wood	$20\frac{7}{12}$	1	$16\frac{2}{12}$	....	......	....	1888
......	Wood	$73\frac{1}{12}$	1	$16\frac{9}{12}$	....	......	8° 50′ R	....
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$71\frac{7}{12}$	1	$17\frac{9}{12}$	....	......	....	1879
......	.....	.....	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$71\frac{8}{12}$	1	$17\frac{10}{12}$	....	......	....	1883
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$71\frac{7}{12}$	1	16	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$71\frac{2}{12}$	1	$18\frac{2}{12}$	....	......	....	1883
......	.....	......	....	......	....	......	....	....
......	Iron .	$125\frac{10}{12}$	1	......	....	......	....	1890
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Iron .	$90\frac{6}{12}$	....	......	1	$6\frac{1}{12}$	....	....
Iron ..	.....	$71\frac{9}{12}$	1	$18\frac{10}{12}$	1	$6\frac{6}{10}$	....	1888
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$71\frac{9}{12}$	1	19	2	$5\frac{10}{12}$	....	1886
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1891
......	Wood	$71\frac{9}{12}$	1	$17\frac{2}{12}$	....	......	1° 05′ R	1885
......	.....	......	....	......	....	......	....	....
......	Wood	20	1	$17\frac{5}{12}$	....	......	....	....
......	Wood	$74\frac{9}{12}$	1	$17\frac{2}{12}$	....	......	2° 30′ R	1881
......	.....	......	....	......	....	......	....	1891
......	.....	......	....	......	....	......	....	....

TABLE No. 4—(Continued)—*Showing the location of*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			ROME LEVEL—(*Continued*).
67	35.84	80.72	Lenox basin road bridge ....
C. 39	.....	86.15	Composite culvert, two openings, two and one-half feet each ....
......	.....	.....	E. C. and N. railroad bridge, pin connected,
C. 40	.....	80.23	Composite culvert, one opening...... ....
68	38.11	15.09	Petersboro street bridge, Canastota (Whipple arch) ....
C. 41	.....	12.52	Arch culvert, two spans, each eight-feet chord ....
69	38.30	2.74	Main street bridge, Canastota (Whipple arch)
C. 42	.....	54.78	Composite culvert, two and one-half feet opening. ....
70	39.86	70.24	Beebee's road bridge (iron chords) ....
C. 43	.....	25.68	Composite culvert, three openings, three feet each ....
71	40.35	13.39	Herrick's farm bridge (iron chords)........
......	.....	10.57	New York Central and Hudson river railroad bridge, lattice (two bridges) .....
......	.....	.....	New York, West Shore and Buffalo railroad bridge, pin connected.................
C. 44	.....	37.78	Composite culvert, three openings.........
72	40.98	2.07	Fuller's road bridge ....
73	41.82	67.21	New Boston road bridge (Whipple arch)...
C. 45	.....	56.12	Composite culvert, Canasaraga creek, ten openings, three and one-half feet each ...
74	42.92	32.03	Canasaraga road bridge (Whipple arch)....
75	44.47	123.97	Chittenango road bridge (Whipple arch)...
......	.....	6.63	Chittenango feeder. The dam and bulkhead of this feeder are located 21$\frac{19}{100}$ chains south of the canal............. .
A. 4	44.82	24.50	Chittenango aqueduct, three spans, twenty feet each...... ....
C. 46	.....	17.38	Arch culvert, four-feet chord ....
77	45.67	50.28	Bolivar road bridge (tubular) ....
C. 47	.....	30.23	Arch culvert, five-feet chords............
79	46.66	49.10	White's road bridge..................
B. H. 6	.....	86.79	Pool's brook waste-weir and bulkhead .....
80	47.85	8.56	Pool's brook road bridge................
81	49.00	91.93	Kirkville road bridge (iron chords)........
C. 48	.....	38.69	Arch culvert, three-feet chord............
C. 49	49.92	35.02	Arch culvert (Lake brook) six-feet chord....
82	52.00	166.63	Manlius Center road bridge (iron chord)....

the structures on the Erie canal, feeders and reservoirs.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	Wood	7 1/12	1	18 1/12	....	......	....	1886
......	......	......	....	......	....	......	....	....
......	Iron..	......	1	17 3/12	....	......	....	1887
......	......	......	....	......	....	......	....	....
Iron..	.....	71 9/12	1	19	2	7 12 1/12	7° 05′ R	1881
......	.....	......	....	......	....	......	....	....
Iron..	.....	71 2/12	1	18 4/12	2	6 2/12	....	....
......	......	......	....	......	....	......	....	....
......	Wood	71 5/12	1	17 3/12	....	......	....	1890
......	......	......	....	......	....	......	....	....
......	Wood	71 6/12	1	11 11/12	....	......	....	1890
......	Iron..	122 11/12	2	15 8/12	....	......	....	1874
......	Iron..	122 11/12	1	15 6/12	....	......	....	1864
			1	15 8/12	....	......	....	
......	Iron..	170 5/12	2	16	....	......	....	1882
......	......	......	....	......	....	......	....	....
......	Wood	71 6/12	1	12 1/12	....	......	....	1885
Iron..	.....	71 5/12	1	17	....	.....	....	1873
......	.....	......	....	......	....	.....	....	1856
Iron..	.....	99 4/12	1	18 2/12	....	.....	48° 25′ R	....
Iron..	.....	93 4/12	1	18 1/12	....	......	39° 30′ L	....
......	.....	......	....	.....	....	......	....	....
......	.....	.....	....	......	....	......	....	1875
......	.....	......	....	......	....	......	....	....
Iron..	.....	70 1/12	1	17 5/12	....	......	....	1888
......	.....	......	....	......	....	......	....	....
......	Wood	71 10/12	1	17	....	......	....	1887
......	.....	......	....	......	....	......	....	1852
......	Wood	71 9/12	1	17	....	......	....	1884
......	Wood	72 1/12	1	18	....	......	....	1891
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	.....	....	......	....	.....
......	Wood	71 1/21	1	17 11/12	....	......	....	1881

TABLE No. 4 — (Continued) — *Showing the location of*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			ROME LEVEL — (*Concluded*).
......	.....	24.99	Syracuse and Chenango Valley railroad bridge (lattice).... ....
83	52.44	10.01	Stearn's farm bridge....................
......	.....	27.46	Limestone feeder. The dam and bulkhead of this feeder are located $66\frac{75}{100}$ chains south of the canal..................
84	.....	1.00	Limestone feeder change-bridge (pipe truss).
A. 5	52.82	2.01	Limestone feeder aqueduct, three spans, twenty feet each.....................
85	.....	21.25	Private foot-bridge......................
86	53.38	23.40	Burdick's road bridge....................
C. 50	.....	40.38	Composite culvert, four-feet openings......
A. 6	54.89	80.58	Butternut creek aqueduct, three spans, twenty feet each ....
......	.....	4.00	Orville feeder. The dam and bulkhead are located $177\frac{38}{100}$ chains south of the canal..
87	.....	1.04	Orville feeder change and road bridge .....
88	57.10	171.30	Thompsons Landing road bridge (Whipple arch) ....
89	57.96	66.65	Private farm bridge at bone yard (wood bents)................................
......	.....	.....	Stop gate east of lock No. 47 ....
......	.....	108.11	N. Y. C. & H. R. R. R. tunnel, two arches.
......	59.31	2.50	Head of lock No. 47, stone, double lock....
			SHORT LEVEL $\frac{188}{1000}$ MILES.
......	.....	.....	Lock No. 47, $10\frac{175}{1000}$ feet lift (eastward)....
90	.....	8.57	Beech street bridge (Whipple arch)........
......	59.50	6.47	Head of lock No. 48, stone, double lock $10\frac{537}{1000}$ feet lift ....
			LEVEL BETWEEN LOCKS NOS. 48 AND 49, $\frac{714}{1000}$ MILES.
......	.....	.....	Lock No. 48, $10\frac{537}{1000}$ feet lift (eastward) ...
91	.....	29.37	William street bridge, Syracuse (Whipple arch) ....
92	.....	22.92	Catharine street bridge, Syracuse (Whipple arch) ....
......	60.21	4.87	Head of lock No. 49, stone, double lock....
			SYRACUSE LEVEL, $5\frac{114}{1000}$ MILES.
......	.....	.....	Lock No. 49, $6\frac{991}{1000}$ feet lift (eastward) ....
93	.....	2.25	Orange street bridge, Syracuse (Whipple arch) ....

the structures on the Erie canal, feeders and reservoirs.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	Iron..	118	1	$15\frac{1}{12}$	....	......	....	1870
......	Wood	$72\frac{2}{12}$	1	$13\frac{1}{12}$	....	......	....	1890
......	.....	......	....	......	....	......	....	.....
......	Iron..	$73\frac{5}{12}$	1	$8\frac{6}{12}$	....	......	....	1879
......	.....	......	....	......	....	......	....	1852
......	Wood	$86\frac{4}{12}$	....	......	1	$6\frac{8}{12}$	....	.....
......	Wood	$70\frac{2}{12}$	1	$18\frac{1}{12}$	....	......	....	1887
......	.....	......	....	......	....	......	....	1871
......	.....	......	....	......	....	......	....	1874
......	.....	......	....	......	....	......	....	.....
......	Wood	$70\frac{2}{12}$	1	13	....	......	....	1887
Iron ..	.....	$81\frac{7}{12}$	1	$18\frac{3}{12}$	....	......	2° 45′ L	1875
......	Wood	$101\frac{2}{12}$	1	13	....	......	....	1888
......	.....	......	....	......	....	......	....	1887
......	.....	......	....	......	....	.....	....	.....
......	.....	......	....	......	....	......	....	1887
......	.....	......	....	......	....	......	....	.....
Iron ..	.....	$102\frac{11}{12}$	1	$19\frac{2}{12}$	2	6	3° 30′ L	1888
......	.....	......	....	......	....	......	....	1887
.....	.....	......	....	......	...	......	....	. ...
Iron ..	.....	$78\frac{7}{12}$	1	$19\frac{4}{12}$	2	7	....	1855
Iron ..	.....	$96\frac{4}{12}$	1	$19\frac{1}{12}$	2	$\left\{\begin{matrix} 6\frac{11}{12} \\ 6\frac{8}{12} \end{matrix}\right.$	....	1885
......	.....	.....	....	......	....	......	....	1887
......	......	......	....	......	....	......	....	....
Iron ..	......	$99\frac{2}{12}$	1	$19\frac{1}{12}$	2	$6\frac{5}{12}$	....	1882

TABLE No. 4 — (Continued) — *Showing the location of*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			SYRACUSE LEVEL — (*Continued*).
94	.....	6.91	Grape street bridge, Syracuse (Whipple arch) ....
95	.....	7.19	Mulberry street bridge, Syracuse (Whipple arch) ....
95½	.....	.....	Syracuse Heat and Power Company bridge (private) ....
C. 51	60.48	5.39	Weigh-lock and culvert under the canal to empty said weigh-lock..................
96	.....	2.66	East towpath bridge over the Oswego canal at the junction (tubular) ....
97	.....	3.82	West towpath bridge over the branch junction (tubular).......................
98	.....	1.73	Warren street bridge, Syracuse (wrought-iron) ....
99	.....	5.48	Foot-bridge on east side of Salina street, Syracuse (private)......................
100	60.67	0.71	Salina street swing-bridge (wrought-iron) ..
101	.....	5.01	Clinton street bridge, Syracuse (Whipple arch) ....
102	.....	7.94	Franklin street foot-bridge, Syracuse ......
......	.....	0.32	Northern railroad swing-bridge, plate girder.
C. 52	.....	9.45	Onondaga creek, arch culvert, two arches, twenty-five feet chord each.............
S. 1	.....	3.23	Spillway at Amos' mills on berme side, 100 feet..................................
103	61.02	1.96	West street lift-bridge..................
104	61.64	49.59	Geddes street bridge, Syracuse (Whipple arch) ....
C. 53	....	14.96	Harbor brook arch culvert, twelve-feet chord ....
......	.....	1.89	New York Central and Hudson River railroad bridge, lattice....................
......	.....	.....	Delaware, Lackawanna and Western railroad bridge, lattice ....
105	62.31	37.39	West Genesee bridge, Syracuse (Whipple arch) ....
106	....	26.53	Bridge street bridge, Syracuse (Whipple arch) ....
107	.....	29.61	Salt Company's bridge (Whipple arch).....
C. 54	.....	4.22	Arch culvert, three-feet chord ....
108	63.52	35.92	Blast furnace road bridge, Syracuse (Whipple arch) ....
108½	.....	.....	Carrying Solvay mains..................
C. 55	.....	14.94	Arch culvert, three-feet chord ....

the structures on the Erie canal, feeders and reservoirs.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
Iron ..	......	$97\frac{1}{12}$	1	18	2	$6\frac{6}{12}$	....	1882
Iron ..	......	$94\frac{4}{12}$	1	24	2	$8\frac{1}{12}$	....	1890
.....	......	... ..	....	......	....	......	....	....
......	......	......	....	......	....	......	....	1866
......	Iron .	$84\frac{11}{12}$	1	$12\frac{3}{12}$	....	......	26° 25′ R	1879
......	Iron .	$66\frac{2}{12}$	1	$12\frac{4}{12}$	....	......	28° 50′ L	1879
Iron ..	......	$69\frac{8}{12}$	2	$20\frac{1}{12}$	2	$12\frac{1}{12}$	....	1889
......	......	......	....	......	....	......	....	1875
......	Iron .	$39\frac{10}{12}$	1	$19\frac{1}{12}$	2	$7\frac{1}{12}$	....	1889
Iron ..	......	$70\frac{9}{12}$	1	21	2	$7\frac{2}{12}$	....	1864
......	Iron .	$77\frac{11}{12}$	....	......	1	9	40′ L	1889
......	Iron .	$59\frac{2}{12}$	1	$7\frac{5}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	......	......	....	......	....	......	....	....
......	Iron .	$62\frac{11}{12}$	1	$21\frac{10}{12}$	2	$6\frac{2}{12}$	22° 00′ R	1888
Iron ..	......	$71\frac{9}{1}$	1	$16\frac{10}{12}$	....	......	1° 45′ L	1889
......	......	......	....	.... .	....	......	....	....
.. ...	Iron .	$118\frac{4}{12}$	2	15	....	......	....	....
......	Iron .	$118\frac{4}{12}$	1	$15\frac{3}{12}$	....	......	....	1863
Iron ..	......	$76\frac{4}{12}$	1	18	2	$6\frac{3}{12}$ $6\frac{7}{12}$	24° 30′ R	....
Iron ..	......	$77\frac{8}{12}$	1	19	1	$5\frac{7}{12}$	....	1886
Iron ..	......	$88\frac{8}{12}$	1	$8\frac{3}{12}$	....	......	....	....
......	......	......	....	......	....	......	....	....
Iron ..	......	$71\frac{9}{12}$	1	$17\frac{2}{12}$	....	......	....	1890
Iron ..	......	$71\frac{9}{12}$	1	......	....	......	....	....
......	......	......	....	......	....	......	....	....

TABLE No. 4 — (Continued) — *Showing the location of*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			SYRACUSE LEVEL — (*Concluded*).
109	64.32	53.85	Gere's landing bridge (iron chords)........
C. 56	.....	58.88	Double arch culvert, each arch four-feet chord..................................
......	65.23	9.29	To foot of lock No. 50..................
			JORDAN LEVEL, $14\frac{903}{1000}$ MILES.
......	.....	.....	Lock No. 50, double lock, $7\frac{872}{1000}$ feet lift, westward ....
110	.....	14.65	Gere's farm bridge ....
C. 57	.....	31.03	Arch culvert, three feet chord ....
111	66.25	35.83	Belle Isle road bridge (Whipple arch) .....
C. 58	.....	60.43	Arch culvert, three-feet chord ....
112	67.14	11.26	Amboy road bridge (Whipple arch) ....
A. 7	68.04	71.30	Nine Mile Creek aqueduct, four spans, thirty-one feet each..................
C. 59	.....	56.00	Arch culvert, four-feet chord ....
......	.....	27.36	Camillus feeder. The dam and bulkhead of this feeder is located $132\frac{20}{100}$ chains south of the canal, and just above the village of Camillus ....
113	69.16	6.70	Camillus road and change bridge..........
R. 1	70.01	68.15	Receiver on berme side ....
114	71.27	100.57	Newport road bridge ....
......	.....	.....	Private bridge at Mellin's cement works....
115	73.85	206.39	Memphis road bridge (iron chord).........
C. 60	.....	63.13	Composite culvert, three openings, three feet each ....
116	75.46	65.92	Peru road bridge (iron chord) ....
......	.....	70.87	Carpenter brook feeder, dam and guard-gate, twelve chains south of the canal....
117	76.39	3.63	Shanty Point farm bridge................
C. 61	.....	1.09	Composite culvert, three openings, four feet each ....
B. H. 7	.....	0.81	Carpenter brook stone waste-weir and bulkhead..................................
C. 62	.....	147.48	Composite culvert, four-feet opening ......
119	78.66	32.45	Beaver street bridge, Jordan village ....
A. 8	.....	21.85	Jordan aqueduct, four spans, twenty feet each..................................
C. 63	.....	.....	Arch culvert at west end of aqueduct for mill powers...... ....
......	.....	4.55	Skaneateles feeder. The dam and bulkhead of this feeder are located $7\frac{5}{100}$ chains south of the canal, and in the village of Jordan.

the structures on the Erie canal, feeders and reservoirs.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	Wood	71	1	$17\frac{10}{12}$	....	......	....	1889
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1885
......	Wood	$71\frac{9}{12}$	1	$12\frac{8}{12}$	....	......	....	1883
......	.....	......	....	......	....	......	....	....
Iron ..	.....	70	1	$17\frac{6}{12}$	....	......	....	1880
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$70\frac{9}{12}$	1	$17\frac{2}{12}$	....	......	....	1880
......	.....	......	....	......	....	......	....	1877
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$71\frac{2}{12}$	1	$13\frac{4}{12}$	....	......	....	1882
......	.....	......	....	......	....	......	....	....
......	Wood	$71\frac{10}{12}$	1	14	....	......	....	1882
......	Iron .	$101\frac{8}{12}$	1	9	....	......	....	1891
......	Wood	$71\frac{7}{12}$	1	$19\frac{5}{12}$	2	$6\frac{4}{12}$	....	1882
......	.....	......	....	......	....	......	....	....
......	Wood	$71\frac{10}{12}$	1	$15\frac{1}{12}$	....	......	....	1883
......	.....	......	....	......	...	......	....	1879
......	Wood	$71\frac{1}{12}$	1	$13\frac{5}{12}$	....	......	....	1882
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1879
......	.....	......	....	......	....	......	....	....
......	Wood	$71\frac{4}{12}$	1	12	....	......	....	1885
......	.....	......	....	......	....	......	....	1891
......	.....	......	....	......	....	......	....	1874
......	.....	......	....	......	....	......	....	....

TABLE No. 4 — (Continued) — *Showing the location of*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			JORDAN LEVEL — (*Concluded*).
120	79.02	2.18	Main street bridge, Jordan (Whipple arch).
121	.....	14.32	Hamilton street bridge, Jordan (iron chords).
C. 64	.....	44.75	Arch culvert, six-feet chord ....
......	80.13	29.45	Head of lock No. 51, double stone lock. ...
			PORT BYRON LEVEL, $7\frac{793}{1000}$.
......	.....	.....	Lock No. 51, $5\frac{580}{1000}$ feet lift, eastward .....
C. 65	.....	16.33	Composite culvert, four and one-half feet openings ....
122	80.46	9.52	Cold Springs road bridge....... ....
123	81.00	45.44	Fountainville road bridge ....
C. 66	.....	19.61	Arch culvert, four-feet chord ....
124	81.32	4.46	Field's road bridge ....
......	.....	.....	New York, West Shore and Buffalo railroad bridge (pin connected)................
C. 67	.....	28.29	Arch culvert, four-feet opening ....
125	.....	11.50	Private foot bridge (suspension) ....
C. 68	.....	35.83	Arch culvert, four-feet chord.............
126	82.76	39.05	Putnam's farm bridge (iron chords) ....
127	83.18	33.38	Young's farm bridge (iron chords) ....
......	.....	5.61	Southern Central railroad bridge (pin connected) ....
C. 69	.....	4.78	Composite culvert, four-feet openings......
......	.....	0.85	Putnam brook feeder ....
B. H. 8	.....	.....	Bulkhead and waste-weir on towpath side (Putnam brook).....................
128	83.53	17.25	Seneca street bridge, Weedsport (Whipple arch) ....
C. 70	.....	19.54	Box culvert (stone), 3x3 feet ....
130	84.08	24.18	Brutus street bridge (Whipple arch).......
......	.....	.....	New York, West Shore and Buffalo railroad bridge (pin connected).................
C. 71	.....	31.99	Composite culvert, four-feet openings......
A. 9	84.91	34.63	Centerport aqueduct, three spans, twenty feet each, stone abutments and piers.....
......	.....	64.95	Centerport feeder ....
133	85.74	1.00	Centerport road bridge (Whipple arch) ....
R. 2	86.28	42.70	Receiver on berme side ....
C. 72	.....	35.17	Composite culvert, four-feet opening ......
C. 73	.....	32.01	Composite culvert, two openings, three feet each ....
134	87.17	4.02	Utica street bridge, Port Byron (Whipple arch) ....

the structures on the Erie canal, feeders and reservoirs.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
Iron ..	.....	$81\frac{11}{12}$	1	18	2	$6\frac{5}{12}$	30° 55′ L	....
......	Wood	$71\frac{4}{12}$	1	$18\frac{1}{12}$	....	......	....	1888
......	.....	......	....	......	....	.....	....	....
......	.....	......	....	......	....	......	....	1887
......	.....	......	....	......	...	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$73\frac{2}{12}$	1	$17\frac{11}{12}$	....	......	....	1875
......	Wood	$72\frac{5}{12}$	1	$13\frac{1}{12}$	....	......	....	1882
......	.....	.....	....	......	....	......	....	....
......	Wood	72	1	$17\frac{7}{12}$	....	......	....	1882
......	Iron .	$108\frac{11}{12}$	2	$15\frac{7}{12}$	....	......	....	1883
......	.....	......	....	......	....	......	....	....
......	Iron .	$85\frac{8}{12}$	....	......	1	$3\frac{5}{12}$	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$72\frac{4}{12}$	1	$12\frac{1}{12}$	....	......	....	1877
......	Wood	$71\frac{4}{12}$	1	$13\frac{10}{12}$	....	......	....	1877
......	Iron .	$106\frac{10}{12}$	1	$15\frac{6}{12}$	....	......	....	1878
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1879
Iron ..	.....	$71\frac{11}{12}$	1	$19\frac{1}{12}$	....	......	....	....
......	.....	......	....	.....	....	......	....	1860
Iron ..	.....	$75\frac{11}{12}$	1	$18\frac{9}{12}$	2	$6\frac{5}{12}$ $6\frac{9}{12}$	17°50′ L	....
......	Iron .	$193\frac{5}{12}$	2	16	....	......	....	1883
......	.....	......	....	......	....	......	....	...
......	.....	. ...	....	......	....	......	....	1891
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$71\frac{8}{12}$	1	$18\frac{11}{12}$	2	6	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	....	......	....	......	....	......	....	....
Iron ..	.....	$98\frac{5}{12}$	1	19	....	......	51° 05′ R	1877

TABLE No. 4—(Continued)—*Showing the location of*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			PORT BYRON LEVEL—(*Concluded*).
135	.....	9 46	Main street bridge, Port Byron (Whipple arch)
C. 74	.....	3.01	Arch culvert, four-feet chord.... ....
A. 10	87.51	14.84	Port Byron aqueduct, four spans, twenty-one feet each, stone abutment and piers......
......	.....	2.97	Port Byron feeder. The dam and bulkhead are located 168 chains south of the canal and south of the village of Port Byron. The water is conducted from the end of the open channel at the well-house, to the canal through an iron pipe forty-two inches in diameter and 859 feet long.....
136	.....	5.74	Owasco street bridge, Port Byron (Whipple arch) ....
137	.....	7.94	Canal street bridge, Port Byron (Whipple arch) ....
C. 75	.....	15.38	Arch culvert, six-feet chord ....
......	87.93	.98	Head of Lock No. 52, stone, double lock ...
			MONTEZUMA LEVEL TO WAYNE COUNTY LINE, $9\frac{88}{1000}$ MILES.
......	.....	.....	Lock No. 52, $11\frac{417}{1000}$ lift, eastward ....
138	88.72	63.63	Houghtaling road bridge (Whipple arch)...
C. 76	.....	148.30	Composite culvert, 3x4 feet openings ......
139	90.64	5.61	McLeod's road bridge (Whipple arch)......
A. 11	.....	9.77	Cranebrook aqueduct, three spans, twenty feet each, stone abutments and piers...
140	.....	9.02	Bucklin's farm bridge....................
C. 77	.....	75.79	Arch culvert, four feet chord.............
S. 2	.....	1.38	Spillway at Montezuma, eighty-two feet long.
141	91.87	1.99	Salt street road bridge, Montezuma (Whipple arch) ... .
142	.....	4.12	High street foot-bridge, tubular...........
......	.....	.26	Cayuga and Seneca canal junction.........
143	91.95	2.40	Change-bridge at junction................
C. 78	.....	22.08	Arch culvert, four-feet chord ....
144	.....	2.01	Clark street bridge, Montezuma...........
A. 12	92.70	35.79	Seneca river aqueduct, thirty-one spans, twenty-two feet each, stone abutments and piers...........................
145	95.01	184.53	May's point road and change-bridge.......
C. 79	.....	20.79	Composite culvert, two openings, three feet each ....
C. 80	.....	80.97	Composite culvert, two openings, three feet each ....
......	97.02	59.40	End of middle division at Wayne county line

the structures on the Erie canal, feeders and reservoirs.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
Iron ..	.....	71 6/12	1	19 1/12	2	6 5/12	7° 15′ R	....
.....	.....	......	....	......	....	......	....	...
......	.....	......	....	......	....	......	....	1888
......	.....	......	....	......	....	......	....	....
Iron ..	.....	74 8/12	1	18 9/12	2	6 9/12	16° 45′ L	1886
Iron ..	.....	71 4/12	1	19	....	......	....	....
.....	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1887
......	.....	......	....	......	....	......	....	....
Iron ..	.....	71 2/12	1	19 1/12	...	......	....	1888
......	.....	......	....	......	....	......	....	....
Iron ..	.....	71 1/12	1	19 1/12	....	......	....	....
......	.....	......	....	......	....	......	......	Plank 1886
......	Wood	70 10/12	1	12 2/12	....	......	....	1883
......	.....	.....	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
Iron ..	.....	71 11/12	1	18 10/12	....	......	....	1865
Iron ..	.....	79 4/12	....	......	1	8 7/12	....	1882
......	.....	......	....	......	....	......	....	....
......	Wood	72	1	12	....	......	....	1872
......	.....	......	....	......	....	......	....	....
......	Wood	72 1/12	1	16 5/12	....	......	....	1883
......	.....	......	....	......	....	......	....	1882 to 1891
......	Wood	71 7/12	1	17 11/12	....	......	....	1885
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....

TABLE No. 4—(Continued)—*Showing the location of*

Number of structure.	Distance from Erie canal in miles—approximate.	Distances in chains and links.	GENERAL DESCRIPTION.
			ORISKANY FEEDER.
1	.....	4.20	Christman's road bridge ....
2	.....	9.50	Christman's farm bridge ....
D. 1	0.53	32.90	Dam in Oriskany creek ....
B. H. 1	0.53	.....	Bulkhead at dam ....
			Summit Level, Chenango Canal.
A. 1	20.30	.....	Aqueduct at Sollsville ....
D. 2	20.30	.....	Dam in old Chenango canal (earth) ....
3	20.91	48.50	Road bridge over old Chenango canal .....
4	22.29	110.80	Cherry Valley road bridge ....
5	23.10	65.00	Farm bridge over old Chenango canal .....
6	23.90	63 78	Road bridge over old Chenango canal .....
......	23.93	3.00	Outlet Leland's ponds..................
7	25.13	96.16	Road bridge over old Chenango canal .....
8	.....	.....	Towpath bridge over Madison brook feeder.
......	25.55	33.55	Outlet Madison brook feeder ....
......	25.60	3.95	Outlet West Branch feeder (Kingsley brook, Bradley brook, Hatch's lake and Eaton reservoir) ....
D. 3	25.61	.....	Dam in Chenango canal (lock No. 77) .....
			Leland's Ponds Feeder and Reservoir.
......	.....	.....	Well-house Leland's ponds ....
D. 4	24.24	.....	Dam Leland's ponds....................
			Madison Brook Feeder.
C. 1	.....	.....	Culvert over Woodman's pond outlet ......
B. H. 2	.....	.....	Bulkhead Madison brook.................
9	.....	.....	Road bridge...........................
D. 5	28.54	.....	Madison brook dam and gate-house........
Sp. 1	.....	.....	Madison brook spillway and three over-falls (stone). ....
			West Branch Feeder.
B. H. 3	25.64	3.00	Bulkhead ....
10	.....	25.10	Abe's road bridge. ....
11	.....	8.50	Weaver's farm bridge ....
12	.....	7.50	Weaver's road bridge...................
13	26.22	5.38	S. B. Burchard's farm bridge ....
14	26.77	44.30	T. Burchard's farm bridge...............
15	.....	19.40	Woodman's farm bridge ....
16	27.95	75.00	Osgood's farm bridge...................
17	.....	22.60	Pierce's farm bridge..................
C. 2	.....	8.50	Beach's culvert ....

the structures on the Erie canal, feeders and reservoirs.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	Wood	$19\frac{5}{12}$	1	21	...	......	....	1885
......	Wood	$19\frac{5}{12}$	1	13	....	......	....	....
......	.....	......	....	......	....	......	....	1888
......	.....	.....	....	......	....	......	....	1884
......	.....	......	....	......	....	......	....	1884
......	.....	......	....	......	....	......	....	1887
......	.....	......	....	......	....	......	....	....
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......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1886
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......	.....	......	....	......	....	......	....	...

TABLE No. 4—(Continued)—*Showing the location of*

Number of structure.	Distance from Erie canal in miles—approximate.	Distances in chains and links.	GENERAL DESCRIPTION.
			West Branch Feeder—(Concluded).
18	.....	4.00	Beach's farm bridge
19	28.61	17.80	Wickwire's road bridge
20	.....	11.96	Wickwire's farm bridge
21	.....	12.21	Wm. Russell's farm bridge
C. 3	.....	24.85	Joslin's culvert
22	29.71	38.68	Russell's road bridge
23	.....	30.43	Shapley's road bridge
24	30.44	28.07	Ladd's road bridge
25	.....	37.70	Chase's farm bridge
26	.....	10.77	S. Sherrill's lower farm bridge
27	.....	13.23	S. Sherrill's upper farm bridge
B. H. 4	31.41	15.80	Bulkhead
D. 6	.....	.....	Dam, west branch, Chenango river
			Chenango River and Eaton Brook.
D. 7	38.50	.....	Eaton reservoir dam and discharge gates. (There are a set of low gates discharging through pipes, and a set of high gates with stone sluices below them)
			Bradley Brook Feeder.
B. H. 5	31.44	1.50	Bulkhead
W. 1	.....	1.00	Waste-weir
28	.....	23.52	Hatch's farm bridge
29	.....	14.81	D. Shapley's lower farm bridge
B. H. 6	32.08	12.47	Bulkhead
D. 8	.....	0.20	Dam in Bradley brook
D. 9	25.90	.....	Bradley brook reservoir dam
Sp. 2	.....	.....	Spillway
B. H. 7	.....	.....	Bulkhead, Hatch's lake outlet
D. 10	36.13	.....	Dam, Hatch's lake
.....	.....	.....	Well-house, Hatch's lake
			Kingsley Brook Feeder.
B. H. 8	32.09	0.50	Bulkhead
30	.....	3.45	A. Sherrill's farm bridge
31	.....	12.60	Sherrill's road bridge
32	.....	16.32	D. Shapley's upper farm bridge
33	33.00	40.37	Wheeler's lower farm bridge
34	.....	15.01	Wheeler's upper farm bridge
C. 4	.....	28.25	Allen's culvert
35	.....	1.60	Allen's farm bridge
36	.....	15.15	Kingsley's farm bridge
B. H. 9	.....	16.10	Bulkhead

the structures on the Erie canal, feeders and reservoirs.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	....	......	....	......	....	....
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......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1882
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1879
......	.....	......	....	......	....	......	....	....
......	.....	......	....	.....	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1882
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	...
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	...	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....

TABLE No. 4 — (Continued) — *Showing the location of*

Number of structure.	Distance from Erie canal in miles — approximate.	Distances in chains and links.	GENERAL DESCRIPTION.
			Kingsley Brook Feeder — (Concluded).
D. 11	33.95	0.20	Dam in Kingsley brook ....
D. 12	.....	.....	Kingsley brook reservoir dam and discharge pipes. (The dam is used as a road.).....
37	.....	.....	Road bridge....... ....
B.H.10	.....	.....	Bulkhead ....
			MOHAWK FEEDER (ROME).
B. H. 1	0.03	2.77	Bulkhead ....
			Mohawk River.
D. 1	.....	7.50	Stone dam in Mohawk river ....
......	8.00	.....	Mohawk river to Delta dam ....
......	18.00	.....	Mohawk river to Lansing kill ....
			Lansing Kill.
......	21.50	.....	Lansing kill to dam, near lock No. 33, Black river canal ....
......	26.00	.....	Lansing kill above dam ....
			Feeder.
......	27.80	.....	Feeder between locks Nos. 63 and 70, Black River canal...........................
			ONEIDA CREEK FEEDER.
1	0.07	5.40	Bridge ....
C. 1	.....	5.05	Culvert .. ..
2	1.19	84.65	Sherman street bridge ....
3	.....	26.40	Elm street bridge ....
......	.....	8.38	New York Central Railroad bridge........
4	.....	3.12	Madison street bridge...................
5	.....	3.20	Phelps street bridge ....
6	.....	13.00	Cherry street bridge....................
7	2.23	29.00	Walnut street bridge ....
C. 2	.....	21.40	Culvert ....
B. H. 1	.....	32.70	Bulkhead ....
D. 1	2.91	0.10	Dam on Oneida creek....................
			COWASSALON FEEDER.
......	0.07	5.30	Guard-gate ....
B. H. 1	.....	21.59	Bulkhead and spillway...................
D. 1	0.40	5.11	Dam in Cowassalon creek................

the structures on the Erie canal, feeders and reservoirs.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1865
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	.....	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	...
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1886
......	.....	......	....	......	....	......	....	1886
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1878
......	.....	......	....	......	....	......	....	1878
......	.....	......	....	......	....	......	....	1858
......	.....	......	....	......	....	......	....	1859
......	.....	......	....	......	....	......	....	1858

TABLE No. 4 — (Continued) — *Showing the location of*

Number of structure.	Distance from Erie canal in miles — approximate.	Distances in chains and links.	GENERAL DESCRIPTION.
			CHITTENANGO FEEDER.
1	0.03	2.30	Erie street bridge
C. 1	.....	4.23	Guard-gates
	.....	1.91	Culvert
B. H. 1	.... .	13.75	Bulkhead
D. 1	0.28	.....	Dam in Chittenango creek
			Chittenango Creek.
D. 2	11.00	.....	Dam at Cazenovia
2	.....	1.50	Mill street bridge
......	.....	10.58	Erieville junction
			Cazenovia Lake Outlet.
B. H. 2	.....	2.57	Bulkhead
3	.....	14.70	Forman street bridge (Whipple)
......	11.51	11.35	Cazenovia lake
			Chittenango Creek.
D. 3	22.00	.....	Erieville reservoir, dam, well-house and discharge pipes
			LIMESTONE FEEDER.
C. 1	0.33	26.75	Culvert
W. 1	....	18.00	Waste-weir on towpath
B. H. 1	0.83	22.00	Bulkhead
D. 1	.....	. ...	Dam in Limestone creek
			Limestone Creek.
D. 2	17.50	.....	DeRuyter reservoir, dam, well-house and discharge pipes
			DeRuyter Reservoir.
......	19.30	.....	Head of reservoir
			Tioughnioga Feeder.
......	.....	.....	Two road bridges, three farm bridges and five stone overfalls in feeder from Tioughnioga river
D. 3	20.30	.....	Dam in Tioughnioga river
			ORVILLE FEEDER.
1	0.08	6.60	Road bridge
2	0.94	68.30	Orville road bridge (Whipple)
W. 1	.....	12.30	Waste-weir
3	1.67	46.50	Dunlap's road bridge

the structures on the Erie canal, feeders and reservoirs.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1858
......	.....	......	....	......	....	......	....	....
......	.....	......	...	......	....	......	....	....
......	.....	......	...	......	....	......	....	1878
......	. ...	......	....	......	....	......	....	1879
......	.....	......	....	......	....	......	....	1865
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$27\frac{6}{12}$	1	$19\frac{8}{12}$	2	$7\frac{1}{12}$	2° L	1881
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1879
......	....	......	....	......	....	......	....	1879
......	.....	......	....	......	....	......	....	1888
.... .	.....	......	....	......	....	......	....	1891
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$41\frac{7}{12}$	1	$17\frac{4}{12}$	....	......	....	....
Iron ..	.....	......	....	......	....	......	....	1879
....	.....	......	...	......	....	. ....	....	1858
......	.....	......	....	......	....	......	... .	1879

TABLE No. 4 — (Continued) — *Showing the location of*

Number of structure.	Distance from Erie canal in miles — approximate.	Distances in chains and links.	GENERAL DESCRIPTION.
			ORVILLE FEEDER — (*Concluded*).
4	2.00	26.06	Steel's farm bridge ....
......	.....	.....	Two overfalls (stone)... ....
B. H. 1	2.22	17.60	Bulkhead...........................
D. 1	2.22	.....	Dam in Butternut creek.................
			Butternut Creek.
D. 2	3.92	.....	Jamesville reservoir dam, well-house and discharge pipes........................
			CAMILLUS FEEDER.
1	0.96	76.60	Street bridge ....
W. 1	.....	.....	Waste-weir ....
......	.....	6.60	Guard-gate ....
B. H. 1	1.69	52.00	Bulkhead...........................
D. 1	1.69	.....	Dam in Nine Mile creek.................
			Nine Mile Creek.
B. H. 2	11.70	.....	Bulkhead ....
D. 2	11.70	.....	Dam at foot of Otisco lake..............
			Otisco Lake Reservoir.
2	17.00	.....	Road bridge near head of lake............
			CARPENTER BROOK FEEDER.
......	.....	12.35	Guard-gates ....
D. 1	.....	.....	Dam in Carpenter's brook ....
D. 2	0.18	2.00	Dam (for reservoir)....................
			JORDAN FEEDER.
1	.....	.....	Street bridge ....
B. H. 1	.....	3.28	Bulkhead ....
B. H. 2	.....	3.52	Bulkhead ....
D. 1	0.09	0.25	Dam in Skaneateles creek ....
			Skaneateles Creek.
D. 2	9.50	.....	Dam at Skaneateles..... ....
B. H. 3	.....	.....	Bulkhead ....
2	9.57	5.50	Bridge over outlet......................
			CENTERPORT FEEDER.
D. 1	0.18	14.00	Dam ....

the structures on the Erie canal, feeders and reservoirs.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	....	......	....	......	....	1886
......	.....	......	....	......	....	......	....	1886
......	.....	......	....	......	...	......	....	1886
......	.....	......	....	......	....	......	....	1886
......	.....	......	....	......	....	......	....	1874
......	Wood	$33\frac{1}{12}$	1	$18\frac{9}{12}$	2	$5\frac{10}{12}$	....	1883
......	.....	......	....	......	....	......	....	1888
......	.....	......	....	... ..	....	......	....	1840
......	.....	......	....	......	....	......	....	1841
......	.....	......	....	......	....	.....	....	1840
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1871
......	.....	......	..	......	....	......	....	1872
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1881
......	.....	......	....	......	....	......	....	1841
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1878
......	.....	......	....	......	....	......	....	1868
......	.....	......	....	......	....	......	....	1885
......	.....	......	....	.....	....	......	....	1887
......	.....	......	....	......	....	......	....	....

TABLE No. 4 — (Continued) — *Showing the location of*

Number of structure.	Distance from Erie canal in miles — approximate.	Distances in chains and links.	GENERAL DESCRIPTION.
			PORT BYRON FEEDER.
R. 1	.....	.....	Receiver at canal........................
......	.....	.....	Wrought-iron pipe ....
......	0.16	.....	Gate-house and well ....
W. 1	0.52	.....	Waste-weir......................... ...
1	1.85	.....	Road bridge..........................
B. H. 1	2.10	.....	Bulkhead ....
D. 1	2.10	.....	Dam in Owasco creek ....
			Owasco Creek.
B. H. 2	.....	.....	Bulkhead ....
D. 2	10.00	.....	Dam at Auburn ....
2	11.25	.....	Road bridge over outlet ....
......	13.00	.....	Owasco lake..........................

the structures on the Erie canal, feeders and reservoirs.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	....	......	....	......	....	1876
......	.....	......	....	......	....	......	....	1876
......	.....	......	....	......	....	......	....	1876
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	.....	....	....
......	.....	......	....	......	....	......	....	1879
......	.....	......	....	......	....	......	....	1873
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1875
......	.....	......	....	......	....	......	....	....
. ....	.....	......	....	......	....	......	....	....

TABLE No. 4—(Continued)—*Showing the length of levels*

(Commencing at the junction of the

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			LEVEL NO. 1, 135$\frac{61}{100}$ CHAINS.
0½	.....	3.65	Change-bridge connected with James street bridge
1	.....	.....	James street bridge, Syracuse (Whipple arch)
2	.....	5.30	Willow street bridge, Syracuse (Whipple arch)
......	.....	.....	N.Y., W.S. & B. railroad lift-bridge, Syracuse.
2½	.....	.....	Salina street foot-bridge, Syracuse (girder) .
3	.26	11.70	Salina street lift-bridge, Syracuse
......	.....	.....	Syracuse and Chenango Valley railroad swing-bridge (plate girder)
4	.....	32.30	Division street bridge, Syracuse (Whipple arch)
5	1.31	51.55	Bear street bridge, Syracuse (Whipple arch)
5½	.....	.....	Stringer bridge over Haskins race
S. 1	.....	.....	Spillway at Haskins' mill, sixty-five feet long
6	.....	20.01	Salina street bridge, Syracuse (Whipple arch)
......	1.69	2.00	Head of lock No. 1, eleven-feet lift, southward
			LEVEL NO. 2, 9$\frac{85}{100}$ CHAINS.
......	.....	.....	Covered sluice around locks Nos. 1 and 2, 430 feet long
7	.....	5.30	Park street bridge, Syracuse (Whipple arch)
......	1.82	4.55	Head of lock No. 2, eleven-feet lift, southward
			LEVEL NO. 3, 9$\frac{90}{100}$ CHAINS.
S. 2	.....	.....	Spillway on berme side
......	1.94	9.90	Head of lock No. 3, stone, ten and one-half feet lift, southward
			LEVEL NO. 4, 435$\frac{28}{100}$ CHAINS.
8	.....	12.70	Change-bridge
......	.....	.....	Side-cut to salt works
C. 1	.....	.....	Composite culvert.
......	.....	.....	N. Y. C. and Hudson R. R R. bridge; freight track (lattice)
S. 3	.....	.....	Spillway, stone
8½	.....	.....	Salt work bridge (Main) Greenpoint
9	2.51	32.54	Greenpoint road and change-bridge (iron chords)
......	.....	.....	Syracuse and Northern railroad bridge (R. W. & O. R. R.) pin connected
C. 2	4.35	147.76	Stone culvert at Liverpool
S. 4	.....	.....	Spillway
10	4.91	44.80	Liverpool road bridge

on the Oswego canal and the structures on each in their order.

Erie and Oswego canals at Syracuse.)

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	Iron .	$73\frac{4}{12}$	1	$11\frac{7}{12}$	....	......	....	....
Iron ..	.....	$73\frac{6}{12}$	2	$22\frac{1}{12}$	2	14	....	1886
Iron ..	.....	$73\frac{9}{12}$	2	$19\frac{10}{12}$	2	$11\frac{6}{12}$	....	....
......	Iron .	$65\frac{7}{12}$	1	29	....	......	....	1883
......	Iron .	$97\frac{8}{12}$	....	......	1	$7\frac{1}{12}$	....	1883
......	Iron .	$79\frac{4}{12}$	1	$25\frac{6}{12}$	2	$6\frac{4}{12}$	....	1883
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$71\frac{7}{12}$	1	19	2	$6\frac{2}{12}$	....	1871
Iron ..	.....	$80\frac{1}{12}$	1	$18\frac{1}{12}$	1	$6\frac{7}{12}$	....	1871
......	Wood	......	....	......	....	......	....	1891
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$71\frac{5}{12}$	1	$18\frac{10}{12}$	2	$6\frac{2}{12}$	....	1891
......	.....	......	....	......	....	......	....	...
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$72\frac{1}{12}$	1	$18\frac{11}{12}$	2	$6\frac{2}{12}$	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$78\frac{7}{12}$	1	$14\frac{6}{12}$	....	......	....	1887
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1885
......	Iron .	$128\frac{8}{12}$	2	$15\frac{6}{12}$	....	......	....	1887
......	.....	......	....	......	....	......	....	....
......	Wood	$72\frac{7}{12}$	1	$10\frac{10}{12}$	....	......	....	....
......	Wood	$72\frac{7}{12}$	$3\left\{\begin{matrix}2\\1\end{matrix}\right.$	$\left.\begin{matrix}12\frac{8}{12}\\11\end{matrix}\right\}$	....	......	....	....
......	Iron .	$139\frac{7}{12}$	1	$15\frac{6}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$73\frac{1}{12}$	1	13	....	......	....	1887

TABLE No. 4—(Continued)—*Showing the length of levels*
(Commencing at the junction of the

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			LEVEL No. 4 — (*Concluded*).
C. 3	5.97	84.90	Culvert ....
11	6.92	76.00	Road change-bridge (Whipple pipe) Mud Lock ....
$11\frac{1}{4}$	.....	.....	Approach east side of bridge No. 11, over State ditch ....
$11\frac{1}{2}$	.....	.....	Outlet bridge (Whipple arch) ....
B. H. 1	.....	.....	Bulkhead, just above lock No. 5, sixteen feet long................ ....
......	7.38	36.58	Head of lock No. 5, $9\frac{68}{100}$ feet lift, southward.
			LEVEL No. 5, $769\frac{60}{100}$ CHAINS. (River.)
......	.....	.....	One sluice, wood, through towpath ....
12	7.89	40.83	Cold Spring bridge (Whipple arch)*......
......	.....	.....	Eleven sluices, wood, through towpath . ..
13	12.72	386.00	Belgium road bridge (Whipple arch)* .....
......	.....	.....	Seven sluices, wood, through towpath .....
14	14.73	160.85	Three River Point towpath and road bridge, six spans, whole length of bridge, $312\frac{5}{12}$ feet, four pier cribs, $10\frac{1}{2}$× each and one pile pier ten feet ....
......	.....	.....	Five sluices, wood, through towpath ......
......	.....	.....	One sluice, stone, through towpath ....
......	.....	.....	Two sluices, wood, through towpath ......
15	16.98	180.12	Lock street bridge, iron chords, connected with river bridge at Phœnix*.........
.....	17.00	1.80	Head of guard-lock No. 1, at Phœnix......
			LEVEL No. 6, $270\frac{19}{100}$ CHAINS.
......	.....	6.60	Phœnix dam, stone spillway, 440 feet long..
16	.....	0.80	Bridge street bridge, Phœnix (iron chords).
17	17.17	6.00	Phœnix change and road bridge...........
C. 4	17.68	40.70	Brandy brook culvert....................
18	20.23	203.87	Change-bridge at Hinmansville ....
19	.....	6.00	Hinmansville road bridge (iron chords)* ...
......	20.38	6.22	Head of lock No. 6, seven-feet lift, southward.
			LEVEL No. 7, $187\frac{30}{100}$ CHAINS.
......	.....	.....	Seven sluices, wood abutments, towpath side ....
......	21.17	63.30	Guard-lock No. 2, on berme side (not used).

* Connected with town

on the Oswego canal and the structures on each in their order.

Erie and Oswego canals at Syracuse.)

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	....	......	....	......	....	....
Iron..	. ...	$71\frac{2}{12}$	1	$13\frac{9}{12}$	....	......	....	...
......	Wood	$40\frac{4}{12}$	1	$14\frac{4}{12}$	....	......	....	1891
Iron..	.....	$82\frac{8}{12}$	1	15	....	......	....	....
......	.....	......	....	......	....	......	....	1883
......	.....	......	....	......	....	......	....	1887
......	.....	......	....	......	....	......	....	....
Iron..	.....	$163\frac{5}{12}$	1	$18\frac{11}{12}$	....	......	....	1871
......	.....	......	...	......	....	......	....	....
Iron..	.....	$107\frac{8}{12}$	1	$17\frac{10}{12}$	....	......	....	1873
......	....	......	....	......	....	......	....	....
......	Wood	$24\frac{8}{12}$ $40\frac{1}{12}$ $45\frac{6}{12}$ $48\frac{2}{12}$ 48 $43\frac{6}{12}$	1	$15\frac{1}{12}$	....	......	....	1884
......	.....	......	....	......	...	......	....	....
......	.....	......	....	.....	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$69\frac{10}{12}$ $64\frac{10}{12}$	1	$20\frac{6}{12}$	....	......	....	1881
......	.....	......	....	......	....	......	....	1887
......	.....	......	....	......	...	......	....	1885
......	Wood	......	1	18	....	......	....	1887
......	Wood	$72\frac{3}{12}$	2	$13\frac{10}{12}$ $10\frac{10}{12}$		......	....	1885
......	.....	......	....	......	....	......	....	....
......	Wood	$73\frac{11}{12}$	1	$13\frac{9}{12}$	...	.....	....	1891
......	Wood	$72\frac{11}{12}$	1	$19\frac{1}{12}$	....	......	....	1879
......	.....	......	....	......	....	......	....	1887
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....

bridges crossing the river.

TABLE No. 4 — (Continued) — *Showing the length of levels*

(Commencing at the junction of the

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			LEVEL No. 7 — (*Concluded*).
S. 5	22.41	99.20	Spillway on berme side
......	22.72	24.80	Head of lock No. 7, $5\frac{866}{1000}$ feet lift, southward
			LEVEL No. 8, $281\frac{91}{100}$ CHAINS.
......	.....	.....	Eleven sluices, wood abutments, through towpath
......	26.24	281.91	Head of guard-lock No. 3, stone
			LEVEL No. 9, $37\frac{65}{100}$ CHAINS.
20	.....	17.05	Pratt street bridge, Fulton
......	.....	.....	Oswego Falls dam, stone spillway, 413 feet long
......	.....	.....	Wicks & Redhead pulp-mill bridge (private)
S. 6	.....	9.10	Spillway on berme side
......	.....	.....	Foundry power bridge (private)
21	.....	3.50	Bro'dw'y bridge, Fulton road (Whipple arch)*
......	26.71	8.00	Head of lock No. 8, $11\frac{25}{100}$ feet lift, southward
			LEVEL No. 10, $46\frac{84}{100}$ CHAINS.
......	29.07	28.34	Side-cut lock, Fulton Mills
......	.....	.....	Box factory bridge (private)
......	.....	.....	Box factory bridge over hydraulic lock (private)
......	.....	.....	Fulton dam, stone spillway, 503 feet long
22	.....	7.84	First street bridge, Fulton (Whipple arch)
23	.....	1.50	Oneida street bridge, Fulton (Whipple arch)
......	.....	.....	State shop
......	27.29	8.36	Head of lock No. 9, $7\frac{25}{100}$ feet lift, southward
			LEVEL No. 11, $11\frac{54}{100}$ CHAINS.
S. 7	.....	10.54	Spillway at head of lock No. 10
......	27.43	1.00	Head of lock No. 10, nine-feet lift southward
			LEVEL No. 12, $96\frac{66}{100}$ CHAINS.
......	.....	.....	Foot-bridge (private) on bents
A. 1	.....	28.00	Aqueduct (one span)
25	27.81	2.24	Plankroad and change-bridge (Whipple arch
26	.....	58.59	Orchard change-bridge (iron chords)
......	28.64	7.83	Head of lock No. 11, $11\frac{666}{1000}$ feet lift southw'd

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* Connected with town

on the Oswego canal and the structures on each in their order.

Erie and Oswego canals at Syracuse.)

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	....	......	....	......	....	1887
......	.....	......	....	......	....	......	....	1888
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1889
......	Wood	$72\frac{11}{12}$	1	14	....	......	....	1886
......	.....	......	....	......	....	......	....	....
......	Iron.	$109\frac{7}{12}$	1	8	....	......	....	....
......	.....	......	....	......	....	......	....	1891
......	Wood	$81\frac{10}{12}$	1	9	....	......	....	....
Iron ..	.....	$76\frac{8}{12}$	1	$19\frac{2}{12}$	2	$6\frac{6}{12}$	....	1888
......	.....	......	....	.....	....	......	....	1891
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$117\frac{9}{12}$	1	$16\frac{2}{12}$	....	......	....	1888
Iron ..	.....	$39\frac{2}{12}$	1	17	....	......	....	....
......	.....	......	....	......	....	......	....	1888
Iron ..	.....	$81\frac{4}{12}$	1	$18\frac{9}{12}$	2	6	....	1870
Iron ..	.....	$76\frac{4}{12}$	1	19 .	2	6	....	1889
......	.....	......	....	......	....	......	....	....
......	.....	.....	....	......	....	......	....	1890
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1890
......	Wood	$88\frac{10}{12}$	....	......	1	$6\frac{10}{12}$	....	....
......	.....	......	....	......	....	......	....	....
Iron ..	.....	77	1 1	18 $10\frac{10}{12}$	..	Road change.	....	....
......	Wood	$77\frac{3}{12}$	1	$12\frac{1}{2}$	....	......	....	1888
......	.....	......	....	......	....	......	....	1889

bridge crossing the river.

TABLE No. 4 — (Continued) — *Showing the length of levels*

(Commencing at the junction of the

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			LEVEL No. 13, $142\frac{14}{100}$ CHAINS.
......	.....	....	Eight sluices, wood abutments, through towpath..............................
26½	.....	.....	Bridge over Black creek, towpath, wooden abutments (stringer)..................
......	.....	.....	One sluice, wood abutments, through towpath
......	30.42	142.14	Head of guard-lock No. 4 (Battle island)...
			LEVEL No. 14, $182\frac{3}{100}$ CHAINS.
......	.....	3.00	Van Buren dam, stone, spillway 662 feet long.
27	.....	10.29	Change-bridge (Battle island) ....
28	32.13	123.43	Change-bridge (Bundyville) ....
......	.....	.....	Three sluices, wood abutments, through towpath..................................
......	32.70	45.31	Head of lock No. 12, $11\frac{25}{100}$ feet lift, southward.
			LEVEL No. 15, 61 CHAINS.
......	33.32	50.20	Minetto dam, stone spillway, 445 feet long .
29	.....	2.30	Minetto road bridge (Whipple arch)*......
......	33.46	8.50	Head of lock No. 13, $5\frac{65}{100}$ feet lift, southward.
			LEVEL No. 16, $92\frac{3}{100}$ CHAINS.
......	.....	.....	Two sluices, wood abutments, through towpath..................................
S. 7½	.....	....	Spillway on berme ....
......	.....	.....	One sluice, stone abutment, towpath side...
......	34.61	92.03	Head of lock No. 14, $9\frac{25}{100}$ feet lift, southward.
			LEVEL No. 17, $84\frac{68}{100}$ CHAINS.
......	.....	.....	High dam, stone, spillway 363 feet long....
......	35.67	84.68	Head of lock No. 15, $5\frac{75}{100}$ feet lift, southward.
			LEVEL No. 18, $30\frac{17}{100}$ CHAINS.
S. 8	.....	.....	Spillway on berme side ....
......	36.04	30.17	Head of lock No. 16, $8\frac{666}{1000}$ feet lift, southward,
			LEVEL No. 19, $81\frac{26}{100}$ CHAINS.
......	.....	.....	Sluice No. 62, stone abutment, through towpath..................................
......	37.00	76.61	Oswego dam, stone spillway 530 feet long..
......	37.06	4.65	Head of guard-lock No. 5 ....
......	.....	.....	River wall from Oswego dam to guard-lock No. 5............................

* Connected with town

on the Oswego canal and the structures on each in their order.

Erie and Oswego canals at Syracuse.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	....	.....	....	......	....	....
......	.....	20	1	$12\frac{1}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1888
......	.....	......	....	......	....	......	....	1891
......	Wood	$74\frac{8}{12}$	1	$12\frac{6}{12}$	....	......	....	1891
......	Wood	$74\frac{10}{12}$	1	$14\frac{3}{12}$	...	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	...	......	....	......	....	1891
......	.....	......	....	......	....	......	....	1884
Iron.	.....	$83\frac{6}{12}$	1	18	....	.....	....	1872
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1890
......	.....	......	....	......	....	......	....	....
......	.....	.....	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1890
......	.....	... ..	....	......	...	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....

bridge crossing the river.

TABLE No. 4—(Continued)—*Showing the length of levels*

(Commencing at the junction of the

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			LEVEL NO. 20, $23\frac{98}{100}$ CHAINS.
......	.....	9.56	Weigh-lock (abandoned)
30	3.85	.....	Hubbard street bridge (iron chords)
C. 4½	.....	.....	Culvert from race to mills
......	37.36	10.57	Head of lock No. 17, $10\frac{50}{100}$ feet lift, southward
			LEVEL NO. 21, $21\frac{10}{100}$ CHAINS.
......	.....	.....	River wall from lock No. 17 to lock No. 18.
C. 5	.....	.....	Culvert
31	.....	11.10	Utica street bridge, Oswego (Whipple cast, deck truss)*
......	.....	.....	Railroad bridge (Midland), Oswego (Whipple cast, double track
S. 9	.....	.....	Spillway on berme
......	37.62	10.00	Head of lock No. 18, $9\frac{25}{100}$ feet lift, southward, at high water and $13\frac{33}{100}$ feet lift, southward, at low-water mark
			LEVEL OF OSWEGO HARBOR AND LAKE ONTARIO.
......	.....	.....	River wall, on berme side, extends from lock No. 18 $11\frac{80}{100}$ chains to the north line of Bridge street and fifty chains from Bridge street to mouth of harbor
......	.....	.....	State shop is located on the berme side of lock No. 18
......	37.78	12.36	Bridge street bridge*
	From lock No. 3.		SALINA SIDE CUT LEVEL (NORTH) $78\frac{78}{100}$ CHAINS.
......	.....	2.50	Head of lock No. 4
1	.....	11.90	Spring street bridge (on bents)
2	0.46	22.05	Third North street bridge (on bents)
3	.....	18.50	Sixth North street bridge (on bents)
S. 1	.....	.....	Spillway and waste-weir
......	10.86	13.83	End of side cut
	From main line.		SALINA SIDE-CUT LEVEL (SOUTH) $93\frac{4}{100}$ CHAINS (INCLUDING SLIPS).
1	0.36	27.78	Park street (or Liverpool road bridge)
2	.....	7.10	Salina street (Whipple arch, cast iron)
3	.....	5.26	Bridge over side-cut to salt blocks (wood abutments)
4	0.60	7.10	Marsh street (stringer)

* Connected with city

on the Oswego canal and the structures on each in their order.

Erie and Oswego canals at Syracuse.)

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	....	......	....	......	....	1866
......	Wood	$79\frac{5}{12}$	1	$19\frac{1}{12}$	....	......	....	1888
......	.....	......	....	......	....	......	....	....
.....	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Iron..	102	1	$20\frac{10}{12}$	2	$7\frac{6}{12}$	....	1869
......	Iron..	$172\frac{4}{12}$	1	19	....	......	....	1876
......	.....	......	....	......	....	......	....	.. .
......	.....	......	....	......	....	......	....	....
......	.....	......	....	.....	....	.. ...	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	.....	....	......	....	......	....	....
......	Wood	$59\frac{6}{12}$.	1	$15\frac{1}{12}$	....	......	....	1888
......	Wood	$58\frac{9}{12}$	1	$11\frac{11}{12}$	....	......	....	1887
......	Wood	$57\frac{6}{12}$	1	$12\frac{1}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	1887
......	.....	......	....	......	....	......	....	....
......	Iron..	$30\frac{8}{12}$	1	$19\frac{1}{12}$	....	......	....	1881
Iron ..	.....	$48\frac{4}{12}$	1	$19\frac{1}{12}$	....	......	....	1887
......	Wood	$38\frac{6}{12}$	1	$10\frac{10}{12}$	....	......	....	....
......	.....	$17\frac{10}{12}$	1	$20\frac{1}{12}$	....	......	....	....

bridges crossing the river.

TABLE No. 4—(Continued)—*Showing the length of levels*
(Commencing at the junction of the

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			SLIPS AT LIVERPOOL 20 CHAINS LONG (AGGREGATE).
.....	.....	.....	Swing-bridge over south slip ....
	From Cold-spring bridge.		SENECA RIVER TOWING-PATH, $466\frac{21}{100}$ CHAINS.
......	5.06	404.76	Float-bridge, 436 feet long ....
......	5.83	61.45	Foot of lock at lower end of side-cut.......
			BALDWINSVILLE SIDE-CUT LEVEL, $46\frac{90}{100}$ CHAINS.
......	5.83	.....	Side-cut lock (wood), ten feet lift, westward.
1	6.08	20.50	Swing-bridge (to saw mill)................
2	6.21	10.30	Swing-bridge (to flour mill) Wilkins......
3	6.29	6.00	Swing-bridge (to flour mill) Frazee........
4	.....	.....	Swing-bridge, railroad bridge ....
5	6.38	7.10	Bridge street (Baldwinsville) wrought-iron .
......	6.43	3.00	Guard-gates at dam ....
......	.....	.....	River dam, 385 feet long.................
6	18.16	.....	Bridge at Jack's reefs....................
	From Oswego river (Three River Point).		ONEIDA RIVER IMPROVEMENT, FROM THREE RIVER POINT TO BREWERTON, 20 MILES. The structures are:
.....	.....	.....	R. W. & O. R. R. bridge, two spans, Howe truss..................................
......	....	.....	One tree dam at Oak Orchard.............
......	8.13	.....	One steamboat lock at Oak Orchard 120 feet long and thirty feet wide, three-feet lift ....
1	.....	.....	One swing-bridge ninety-five feet long, forty-five feet opening at Oak Orchard*.......
......	.....	.....	One crib and stone dam at Caughdenoy....
......	14.49	.....	One steamboat lock at Caughdenoy 120 feet long, thirty feet wide, three-feet lift .....
2	.....	.....	One swing-bridge over lock, thirty-one feet opening* ....
......	.....	.....	R. W. & O. R. R. bridge { three fixed spans.. one swing ....
3	18.79	.....	One swing-bridge at Brewerton eighty-five feet long, forty-five feet opening* ... ...

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* These are connected with town

on the Oswego canal and the structures on each in their order.

Erie and Oswego canals at Syracuse.)

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	...	......	....	......	....	1886
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	1865
......	Wood	$19\frac{10}{12}$	1	$11\frac{6}{12}$	....	......	....	.....
......	Wood	$25\frac{8}{12}$	1	$9\frac{4}{12}$	....	......	....	.....
......	Wood	$21\frac{10}{12}$	1	$11\frac{2}{12}$	...	......	....	.....
......	Wood	26	1	$14\frac{4}{12}$	1	$3\frac{4}{12}$	....	.....
Iron ..	.....	$45\frac{1}{12}$	1	$26\frac{1}{12}$	2	$9\frac{10}{12}$	....	1870
......	.....	......	....	......	....	......	....	1867
......	.....	......	....	......	....	......	....	...
Iron ..	.....	98	....	......	....	......	....	1887
......	Wood	......	1	......	...	......	....	.....
......	.....	......	....	......	....	......	....	1867
......	.....	......	....	......	....	......	....	.....
.....	Wood	45	1	......	....	......	....	1885
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	Wood	31	1	......	....	......	....	1888
......	Wood	......	1	......	....	......	....	1882
......	Iron..	......	1	......	....	......	....	1888
......	Iron..	45	1	14	....	......	....	1883

bridges crossing the river.

TABLE No. 4 — (Continued) — *Showing the length of the levels on the at Montezuma, and their structures, each in their order, including the*

Number of structure.	Cumulative distance in miles from Erie canal.	Distances in chains and links.	GENERAL DESCRIPTION.
			SENECA LAKE LEVEL NO. 1, $630\frac{67}{100}$ CHAINS.
......	20.88	.....	Piers in harbor at Geneva ....
......	20.54	27.80	Towpath bridge No. 1 over Castle creek, Geneva (stringers) ....
1	20.51	2.50	Lake street bridge, Geneva (Whipple arch).
......	......	......	Iron-truss carrier to malt-house (private)...
......	20.13	29.85	Towpath bridge No. 2, four spans (pile bents).
2	19.99	11.70	Evans street bridge (Whipple arch) ....
3	19.63	28.35	Pre-emption road bridge (Whipple arch)...
......	19.45	14.90	Towpath bridge No. 3, twenty-two spans, (pile bents)...........................
......	.....	.....	Three sluices ....
4	18.74	55.70	Teal's road bridge (Whipple arch) ....
5	18.37	.....	New outlet bridge........................
......	.....	.....	Geneva, Ithaca and Sayre railroad bridge (pin-connected) ....
......	.....	.....	Eight sluices ....
......	14.10	371.85	Towpath bridge No. 4, over White creek (stringer) ....
......	.....	.....	One sluice..............................
D. 1	.....	50.55	Waterloo stone dam, 130½ feet long........
6	13.44	2.10	Locust street road and change-bridge Whipple arch) ....
......	.....	14.45	Towpath bridge No. 5, over factory flume, two spans ....
7	13.23	2.50	Virginia street bridge, Waterloo (Whipple arch) ....
......	.....	.....	Two sluices ....
......	13.00	18.42	Foot of lock No. 1, $7\frac{28}{100}$ feet lift, westward.
			LEVEL NO. 2, $12\frac{60}{100}$ CHAINS.
8	.....	6 25	Swift street bridge (Whipple arch)........
......	.....	3.40	Towpath No. 6, draw-bridge to dry dock ..
......	12.84	2.95	Foot of lock No. 2, seven-feet lift, westward.
			LEVEL NO. 3, $261\frac{45}{100}$ CHAINS.
......	.....	3.65	Towpath bridge No. 7, four spans ....
9	.....	13.50	Gorham road bridge....................
......	.....	3.10	Towpath bridge No. 8, four spans ....
......	12.39	16.20	Towpath bridge No. 9, over Silver creek (stringer) ....
10	11.14	99.60	Kingdom road bridge....................
......	10.60	43.50	Towpath bridge No. 10, over Sackett's creek (stringer) ....

Cayuga and Seneca canal from Geneva to the junction of the Erie canal
Cayuga side-cut from Mud lock to Cayuga bridge and Cayuga inlet.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	....	......	....	......	....	....
......	.....	15	1	12	....	......	....	....
Iron ..	.....	$69\frac{1}{12}$	2	$17\frac{10}{12}$	2	$6\frac{6}{12}$	....	....
......	.....	......	....	......	....	......	....	....
......	.....	$60\frac{1}{12}$	1	$15\frac{2}{12}$	....	......	....	....
Iron ..	.....	$79\frac{11}{12}$	1	18	....	......	....	1873
Iron ..	.....	$70\frac{10}{12}$	1	19	....	......	....	1881
......	... .	265	1	$15\frac{3}{12}$	....	......	....	1874
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$71\frac{2}{12}$	1	18	....	......	....	1874
Iron ..	.....	......	....	......	....	......	....	1869
......	Iron ..	$84\frac{3}{12}$	1	$15\frac{6}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	....	19	1	12	....	......	....	1888
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1885
Iron ..	.....	$83\frac{11}{12}$	1 1	17 $8\frac{3}{12}$		.....	....	1870
......	.....	$21\frac{10}{12}$ $21\frac{4}{12}$	1	$12\frac{6}{12}$	....	......	....	....
Iron ..	.....	$83\frac{6}{12}$	2	18	2	$6\frac{10}{12}$	....	1890
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
Iron ..	... .	$70\frac{3}{12}$	1	$18\frac{8}{12}$	....	......	....	1890
......	.....	$21\frac{8}{12}$	1	$11\frac{1}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	1870
......	Wood	$113\frac{6}{12}$	1	$9\frac{3}{12}$	....	......	....	1887
......	Wood	$75\frac{1}{12}$	1	$18\frac{2}{12}$	....	......	....	1882
......	Wood	$151\frac{1}{12}$	1	$9\frac{4}{12}$	....	......	....	1881
......	. ...	$30\frac{5}{12}$	1	$10\frac{1}{12}$	....	......	....	....
......	Wood	$73\frac{5}{12}$	1	$16\frac{9}{12}$	....	......	... ...	1883
......	.....	$17\frac{7}{12}$	1	$11\frac{1}{12}$	....	......	....	....

TABLE No. 4—(Continued)—*Showing the length*

Number of structure.	Cumulative distance in miles from Erie canal.	Distance in chains and links.	GENERAL DESCRIPTION.
			LEVEL No. 3 (*Concluded*).
......	.....	.....	Sodus Bay railroad bridge, Howe ....
11	9.71	70.90	Bridge street, Seneca Falls (Whipple arch).
D. 2	.....	3.90	Seneca Falls stone dam, 180 feet long......
S. 1	.....	1.30	Spillway on towpath side.................
......	9.58	5.80	Foot of lock No. 3, ten feet lift, westward..
			LEVEL No. 4, $7\frac{72}{100}$ CHAINS.
S. 2	.....	.....	Spillway, stone, on berme ....
......	.....	3.80	Towpath bridge No. 11, two spans. ....
......	9.48	3.92	Foot of lock No. 4, nine-feet lift, westward .
			LEVEL No. 5, $9\frac{15}{100}$ CHAINS.
12	.....	0.63	Ovid street bridge, Seneca Falls (deck truss).
......	9.36	8.52	Foot of lock No. 5, nine-feet lift, westward.
			LEVEL No. 6, 35 CHAINS.
S. 3	.....	10.73	Spillway, 217 feet long (berme)...........
13	.....	8.40	Seneca street, change and road bridge......
......	8.91	15.87	Foot of lock No. 6, $9\frac{60}{100}$ feet lift, westward.
			LEVEL No. 7, $38\frac{55}{100}$ CHAINS.
......	.....	8.68	Towpath bridge No. 12, five spans.........
D. 3	.....	2.50	Dam 217 feet long ....
......	8.44	27.37	Foot of lock No. 7, six-feet lift, westward..
			LEVEL No. 8, $267\frac{3}{100}$ CHAINS.
......	.....	.....	Six sluices through towpath...............
......	.....	136.13	N.Y.C. & H. R. R.R. bridge, old road, lattice
......	.....	.....	One sluice through towpath..............
14	6.74	22.50	Demont's road bridge....................
D. 4	.....	15.60	River dam, loose stone on berme side......
......	5.11	92.80	Foot of lock No. 8, $5\frac{70}{100}$ feet lift, westward.
			LEVEL No. 9, $9\frac{70}{100}$ CHAINS.
......	.....	.....	This level crosses Cayuga outlet on same level with Cayuga lake.................
......	.....	7.10	Towpath bridge No. 13, over outlet (stone abutments, five spans) ....
......	4.99	2.60	Head of lock No. 9, ten-feet lift, eastward..
			LEVEL No. 10, $391\frac{64}{100}$ CHAINS.
15	.....	1.65	Change bridge at junction with the Cayuga side-cut ....

of the levels on the Cayuga and Seneca canal, etc.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	Wood	......	....	......	....	......	....	....
Iron ..	.....	$72\frac{7}{12}$	2	$15\frac{10}{12}$	2	$8\frac{4}{12}$	....	1872
......	.....	......	....	......	...	......	....	1882
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1870
......	.....	......	....	......	....	.....	....	....
......	Wood	$51\frac{10}{12}$ $42\frac{4}{12}$	1	$10\frac{1}{12}$	....	......	....	1887
......	.....	......	....	......	....	......	....	....
......	Iron..	$52\frac{10}{12}$	1	26	2	9	....	1871
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Iron..	$74\frac{4}{12}$	1	20	....	......	....	1891
......	.....	......	....	......	....	......	....	....
......	Wood	$233\frac{6}{12}$	1	$11\frac{3}{12}$	....	......	....	1885
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1888
......	Iron..	$105\frac{10}{12}$	1	$14\frac{7}{12}$	....	......	....	1870
......	.....	......	...	......	....	......	....	1888
......	Wood	$69\frac{9}{12}$	1	$16\frac{4}{12}$	....	......	....	1882
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1890
......	.....	......	....	......	....	......	....	....
......	Wood	$259\frac{9}{12}$	1	$10\frac{11}{12}$	....	......	....	1887
......	.....	......	....	......	....	......	....	1870
......	Wood	$71\frac{6}{12}$	1	$12\frac{3}{12}$	....	......	....	1879

TABLE No. 4 — (Continued) — *Showing the length*

Number of structure.	Cumulative distance in miles from Erie canal.	Distances in chains and links.	GENERAL DESCRIPTION.
			LEVEL NO. 10, $391\frac{54}{100}$ CHAINS — (*Continued*).
16	3.85	89.05	Free road bridge (Whipple arch)
C. 1	.....	.....	Diving culvert (small)
17	3.56	23.40	Stahlnecker's farm bridge
2 to 8	.....	.....	Seven diving culverts (small)
19	0.54	241.50	Ransom's road bridge
C. 9	....	30.86	Diving culverts
......	0.09	5.08	Head of lock No. 11, three-feet lift eastward
			LEVEL NO. 11, MONTEZUMA, $7\frac{36}{100}$ CHAINS.
......	.....	7.36	Junction with Erie canal
			CAYUGA BRANCH LEVEL, NO. 10, $140\frac{97}{100}$ CHAINS.
......	4.97	.....	Junction with main line
......	.....	3.15	Waste-weir
......	.....	137.82	Head of lock No. 10, ten-feet lift eastward
			CAYUGA LAKE LEVEL, $27\frac{78}{100}$ CHAINS.
19	.....	1.00	Swing-bridge over lock chamber
......	.....	14.87	Tow-path bridge No. 14
......	.....	1.60	N. Y. C. and H. R. R. R. bridge (old road) lift-bridge
......	.....	0.40	Pier at Cayuga, 654 feet long
......	.....	9.91	Cayuga harbor
			CAYUGA INLET.
......	.....	.....	One main pier, 1,000 feet long at Ithaca
......	.....	.....	One breakwater, 306 feet long, at Ithaca
......	.....	.....	One light-house at Ithaca
1	.....	.....	Iron swing-bridge at Buffalo street, Ithaca
2	.....	.....	Iron swing-bridge at Seneca street, Ithaca
3	.....	.....	Iron swing-bridge at State street, Ithaca

of the levels on the Cayuga and Seneca canals, etc.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
Iron ..	.....	$76\frac{5}{12}$	1	$18\frac{9}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	72	1	$12\frac{9}{12}$	....	......	....	1878
......	.....	......	....	......	....	......	....	....
......	Wood	$71\frac{9}{12}$	1	17	....	......	....	1887
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	.....	....	1887
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1870
......	.....	......	....	......	....	......	....	1890
......	.....	......	....	......	....	......	....	1888
......	Iron ..	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	.....	....	......	....	1889
......	.....	......	....	......	....	......	....	1889
......	.....	......	....	......	...	......	....	....
......	.....	......	....	......	....	......	....	1889
......	.....	......	....	......	....	.....	....	....
......	.....	......	....	......	....	......	....	....

TABLE No. 4—(Continued)—*Showing the length of the levels*

(From the intersection

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			LEVEL No. 1, $6\frac{40}{100}$ CHAINS
......	.....	.....	Junction with Erie canal ....
1	.....	0.50	Whitesboro street bridge, Rome, stone abutments (Whipple arch)................
......	0.08	5.90	Foot of lock No. 1, ten-feet lift, northward.
			LEVEL No. 2, $16\frac{80}{100}$ CHAINS.
2	.....	4.22	Dominick street bridge, Rome, stone abutments (Whipple arch)...............
......	0.29	12.58	Foot of lock No. 2, ten-feet lift, northward.
			LEVEL No. 3, $13\frac{83}{100}$ CHAINS.
3	.....	10.36	Stanwix street bridge, stone abutments (Whipple arch)....................
......	0.44	3.47	Foot of lock No. 3, ten-feet lift, northward.
			LEVEL No. 4, $32\frac{14}{100}$ CHAINS.
4	.....	4.53	Thomas street bridge, stone abutments (iron chords)............................
5	.....	.....	Bloomfield street bridge, stone abutments ..
......	0.86	27.61	Foot of lock No. 4, ten feet lift, northward.
			LEVEL No. 5, $52\frac{68}{100}$ CHAINS.
6	.....	50.70	Huntington farm bridge (on bents, iron chords)............................
......	1.52	1.98	Foot of lock No. 5, ten-feet lift, northward.
			LEVEL No. 6, $54\frac{99}{100}$ CHAINS.
7	2.12	48.03	Dunham farm bridge (stone abutments on tow-path side and bents on berme side)..
......	.....	6.96	Foot of lock No. 6, ten-feet lift, northward,
			LEVEL No. 7, $226\frac{97}{100}$ CHAINS.
8	2.51	23.99	Water-works bridge (stone abutments) Whipple arch ....
9	.....	.....	Farm bridge (on bents), Crowells ....
10	.....	.....	Farm bridge (on bents), Wilcox ....
C. 1	3.49	78.18	Culvert (arch) ....
S. 1	.....	0.75	Spillway (near culvert) ....
11	.....	.....	Farm bridge (on bents), Adams...........
12	.....	.....	Farm bridge (on bents), Hicks...........
13	5.00	120.31	Road bridge near river crossing (on bents)..
......	5.05	3.74	Foot of lock No. 7, ten-feet lift, northward.

on Black River canal, and the structures on each in their order.

with Erie canal at Rome.)

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	......	......	....	......	....	......	....	....
Iron ..	......	$71\frac{9\frac{1}{2}}{12}$	1	$18\frac{10}{12}$	1	$7\frac{6}{12}$	....	....
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$55\frac{3}{12}$	2	$13\frac{6}{12}$ $13\frac{6}{12}$	2	$6\frac{6}{12}$ $6\frac{4}{42}$	....	1870
......	....	......	....	......	....	......	....	....
Iron ..	.....	$50\frac{7}{12}$	1	$18\frac{9}{12}$	2	$6\frac{2}{12}$ $6\frac{4}{12}$	....	....
......	......	......	...	......	....	......	....	....
......	Wood	$49\frac{11}{12}$	1	$13\frac{11}{12}$	1	$5\frac{6}{12}$	....	1886
......	Iron .	$48\frac{10}{12}$	1	$19\frac{8}{12}$	2	$7\frac{6}{12}$	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$51\frac{10}{12}$	1	$11\frac{11}{12}$	....	......	....	1888
.....	.....	......	....	... ..	....	......	....	....
......	Wood	$43\frac{6}{12}$	1	$13\frac{4}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$48\frac{5}{12}$	1	$18\frac{2}{12}$	....	......	....	....
......	Wood	$49\frac{11}{12}$	1	12	....	......	....	1885
......	Wood	51	1	12	....	......	.... ..	1888
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$50\frac{1}{12}$	1	$12\frac{2}{12}$	....	......	....	1888
......	Wood	$50\frac{3}{12}$	1	12	....	......	....	1885
......	Wood	$48\frac{10}{12}$	1	12	....	......	....	....
......	.....	......	....	......	....	......	....	....

TABLE No. 4—(Continued)—*Showing the length*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			LEVEL No. 8, $40\frac{2}{100}$ CHAINS.
.....	5.55	40.02	Foot of lock No. 8, eleven-feet lift, northward
			LEVEL No. 9, $10\frac{84}{100}$ CHAINS.
A. 1	.....	5.00	Mohawk aqueduct, stone abutments and wooden trunks, four spans, forty feet each; piers five feet wide ....
......	.....	3.56	Delta feeder is taken into the canal seventy-five links north of the aqueduct..........
......	5.68	2.28	Foot of lock No. 9, twelve feet lift, northward ....
			LEVEL No. 10, $11\frac{4}{100}$ CHAINS.
......	5.82	11.04	Foot of lock No. 10, eleven-feet lift, northward ....
			LEVEL No. 11, $12\frac{43}{100}$ CHAINS.
14	.....	6.59	Change and road bridge (on bents), Walworths ....
......	5.98	5.84	Foot of lock No. 11, eleven-feet lift, northward ....
			LEVEL No. 12, $8\frac{29}{100}$ CHAINS.
......	6.08	8.29	Foot of lock No. 12, eleven-feet lift, northward ....
			LEVEL No. 13, $36\frac{86}{100}$ CHAINS.
15	.....	34.58	Road bridge (stone abutments)............
......	6.54	2.28	Foot of lock No. 13, eight-feet lift, northward ....
			LEVEL No. 14, $168\frac{30}{100}$ CHAINS.
A. 2	.....	.....	Aqueduct over old B. R. & O. R. R. cutting, one span, stone abutments, wooden trunk.
16	6.85	24.78	Farm bridge, stone abutments, iron chords (private) ....
17	7.34	48.82	Farm bridge (on bents), Wager...........
18	7.92	36.70	Farm bridge (on bents), Brayton..........
S. 2	.....	16.25	Spillway ....
19	8.24	9.44	South road bridge at Westernville (stone abutments), tubular ....
20	.....	28.61	Road bridge (on bents), Floyd............
......	8.64	3.20	Foot of lock No. 14, eight-feet lift, northward ....

of the levels on the Black River canal, etc.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	....	......	....	... ..	....	....
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	....	......	....	. ...	....	......	....	.....
......	Wood	$48\frac{9}{12}$	1	$11\frac{8}{12}$	....	......	....	1885
......	. ...	......	....	......	....	......	....	.....
......	.....	......	....	.....	....	......	....	1890
......	Wood	$49\frac{7}{12}$	1	$16\frac{2}{12}$	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	Wood	$46\frac{11}{12}$	1	$11\frac{5}{12}$	...	......	....	.....
......	Wood	$49\frac{8}{12}$	1	$11\frac{7}{12}$	....	......	....	.....
......	Wood	$50\frac{1}{12}$	1	12	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
Iron ..	.....	$48\frac{4}{12}$	1	$18\frac{8}{12}$	....	......	... ...	1882
......	Wood	$49\frac{5}{12}$	1	$11\frac{10}{12}$	....	......	....	1886
......	.....	......	.. .	......	....	......	....	.....

TABLE No. 4—(Continued)—*Showing the length*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			LEVEL NO. 15, $10\frac{90}{100}$ CHAINS.
......	8.78	10.90	Foot of lock No. 15, eight-feet lift, northward ....
			LEVEL NO. 16, $12\frac{87}{100}$ CHAINS.
......	8.94	12.87	Foot of lock No. 16, ten-feet lift, northward.
			LEVEL NO. 17, $119\frac{23}{100}$ CHAINS.
21	.....	7.24	Westernville north road bridge (stone abutments), iron chord.....................
22	9.63	47.74	Farm bridge (on bents), Waldo...........
23	.....	17.50	Farm bridge (on bents), iron chords, Beckwith.
......	10.43	46.75	Foot of lock No. 17, eight-feet lift, northward ....
			LEVEL NO. 18, $48\frac{26}{100}$ CHAINS.
A. 3	.....	4.52	Aqueduct (Willis creek), stone abutments and piers, wood trunks, six spans, eighteen feet; each pier five feet wide........ .....
24	.....	.....	Waldo South Farm bridge (on bents)......
25	.....	.....	Farm bridge (on bents), Waldo (north)....
......	11.04	43.74	Foot of lock No. 18, ten-feet lift, northward
			LEVEL NO. 19, $19\frac{94}{100}$ CHAINS.
26	.....	.....	Farm bridge (on bents) Utley ....
......	11.28	19.94	Foot of lock No. 19, eight-feet lift, northward
			LEVEL NO. 20, $12\frac{95}{100}$ CHAINS.
......	11.44	12.95	Foot of lock No. 20, ten-feet lift, northward.
			LEVEL NO. 21, $11\frac{83}{100}$ CHAINS.
C. 2	.....	4.66	Utley culvert..........................
......	11.59	7.17	Foot of lock No. 21, ten-feet lift, northward.
			LEVEL NO. 22, $44\frac{20}{100}$ CHAINS.
27	.....	9.80	Old plank-road bridge (stone abutments), Whipple arch........................
28	.....	.....	Farm bridge, dry stone abutments (Buck Hill) ....
......	12.15	34.49	Foot of lock No. 22, ten-feet lift, northward.
			LEVEL NO. 23, $69\frac{44}{100}$ CHAINS.
A. 4	...	4.34	Aqueduct (Stringer creek) stone abutments and piers, wood trunk, four spans, eighteen feet each; piers five feet wide...... ...

of the levels on the Black River canal, etc.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
.....	.....	......	....	......	....	.....	....	.....
......	.....	......	....	......	....	......	....	.....
......	Wood	$58\frac{10}{12}$	1	$16\frac{9}{12}$	....	......	....	1888
......	Wood	$49\frac{4}{12}$	1	12	....	......	....	.....
......	Wood	$50\frac{5}{12}$	1	$12\frac{2}{12}$	....	.... .	....	.....
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	1885
......	Wood	$49\frac{6}{12}$	1	$12\frac{2}{12}$	....	......	....	1886
......	Wood	$50\frac{3}{12}$	1	$11\frac{6}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....
.....	Wood	50	1	$11\frac{8}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
.....	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
Iron..	.....	$49\frac{2}{12}$	1	$18\frac{10}{12}$	2	$6\frac{2}{12}$	....	....
......	Wood	$48\frac{5}{12}$	1	12	....	......	....	1865
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....

TABLE No. 4 — (Continued) — *Showing the length*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			LEVEL No. 23 — (*Continued*).
29	.....	6.80	Side Hill road bridge (stone abutments), Whipple arch........................
......	13.02	58.30	Foot of lock No. 23, ten-feet lift, northward.
			LEVEL No. 24, 29$\frac{10}{100}$ CHAINS.
......	13.38	29.10	Foot of lock No. 24, ten-feet lift, northward.
			LEVEL No. 25, 39$\frac{55}{100}$ CHAINS.
30	.....	17.80	Road and change-bridge (on bents)..........
......	.....	.....	Sluice on tow-path side (stone abutments)..
......	13.87	21.75	Foot of lock No. 25, ten-feet lift, northward.
			LEVEL No. 26, 30$\frac{52}{100}$ CHAINS.
A. 5	.....	3.45	Aqueduct, Lansingkill, stone abutments, wood trunks, six spans, eighteen feet each; five piers............................
......	14.26	27.07	Foot of lock No. 26, ten-feet lift, northward.
			LEVEL No. 27, 29$\frac{93}{100}$ CHAINS.
......	14.63	29.93	Foot of lock No. 27, ten-feet lift, northward.
			LEVEL No. 28, 22$\frac{97}{100}$ CHAINS.
......	14.92	22.97	Foot of lock No. 28, ten-feet lift, northward.
			LEVEL No. 29, 12$\frac{16}{100}$ CHAINS.
......	15.07	.....	Foot of lock No. 29, ten feet lift, northward.
			LEVEL No. 30, 34$\frac{99}{100}$ CHAINS.
C. 3	.....	5.29	Culvert (arch)..........................
31	....	3.80	Road-bridge (on bents), Hall.............
......	15.51	25.90	Foot of lock No. 30, ten-feet lift, northward.
			LEVEL No. 31, 16$\frac{60}{100}$ CHAINS.
......	15.71	16.60	Foot of lock No. 31, ten-feet lift, northward.
			LEVEL No. 32, 33$\frac{40}{100}$ CHAINS.
C. 4	.....	3.49	Culvert (arch) ....
......	16.13	29.91	Foot of lock No. 32, ten-feet lift, northward.
			LEVEL No. 33, 31 CHAINS.
......	16.52	31.00	Foot of lock No. 33, ten-feet lift, northward

of the levels on the Black River canal, etc.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
Iron..	.....	$51\frac{2}{12}$	1	16	....	......	....	1883
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
.....	Wood	$49\frac{5}{12}$	1	$13\frac{8}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1886
......	Wood	$48\frac{9}{12}$	1	13	...	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	...
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....

TABLE No. 4—(Continued)—*Showing the length*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			LEVEL NO. 34, $17\frac{82}{100}$ CHAINS.
B. H. 1	.....	15.72	Lansingkill dam and feeder on tow-path, side abutments of dam and bulkhead of stone masonry..............................
......	16.74	2.10	Foot of lock No. 34, ten-feet lift, northward.
			LEVEL NO. 35, $12\frac{52}{100}$ CHAINS.
......	16.90	12.52	Foot of lock No. 35, ten-feet lift, northward.
			LEVEL NO. 36, $10\frac{99}{100}$ CHAINS.
......	17.04	10.99	Foot of lock No. 36, ten-feet lift, northward.
			LEVEL NO. 37, $11\frac{83}{100}$ CHAINS.
C. 5	.....	4.00	Culvert (arch) ....
......	17.18	7.88	Foot of lock No. 37, ten-feet lift, northward.
			LEVEL NO. 38, $12\frac{17}{100}$ CHAINS.
......	17.34	12.17	Foot of lock No. 38, ten-feet lift, northward.
			LEVEL NO. 39, $15\frac{74}{100}$ CHAINS.
S. 3	.....	.....	Spillway, tow-path side...................
......	17.53	15.74	Foot of lock No. 39......................
......	.....	.....	Combined locks, Nos. 39, 40, 41, 42 and 43, each ten-feet lift, northward ....
......	.....	5.45	Foot of lock No. 43 ....
			LEVEL NO. 40, $18\frac{50}{100}$ CHAINS.
......	17.83	18.50	Foot of lock No. 44......................
......	.....	.....	Combined locks, Nos. 44, 45 and 46, each ten-feet lift, northward ....
......	.....	2.72	Foot of lock No. 46......................
			LEVEL NO. 41, $33\frac{45}{100}$ CHAINS.
32	.....	.....	Tutts' road bridge (above three combined), stone abutments......................
......	18.28	33.45	Foot of lock No. 47, ten-feet lift, northward.
			LEVEL NO. 42, $26\frac{70}{100}$ CHAINS.
33	.....	....	Road bridge (Hart) ....
B. H. 2	.....	.....	Bulkhead on towpath side.......... .....
......	18.62	26.70	Foot of lock No. 48, ten-feet lift, northward.
			LEVEL NO. 43, $9\frac{11}{100}$ CHAINS.
......	18.73	9.11	Foot of lock No. 49, ten-feet lift, northward.

of the levels on the Black River canal, etc

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	....	.. ...	....	......	....	1882
......	.....	......	....	....	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	.....	....	......	....	......	....	....
....	.....	......	....	......	....	......	....	....
......	Wood	$49\frac{4}{12}$	1	12	....	......	....	1883
......	.....	......	....	......	....	......	....	...
......	Wood	$49\frac{4}{12}$	1	$11\frac{8}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1888
......	.....	......	....	......	....	......	....	....

TABLE No. 4 — (Continued) — *Showing the length*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			LEVEL No. 44, $8\frac{68}{100}$ CHAINS.
......	18.84	8.68	Foot of lock No. 50, ten-feet lift, northward.
			LEVEL No. 45, $18\frac{40}{100}$ CHAINS.
......	19.07	18.40	Foot of lock No. 51, ten-feet lift, northward.
			LEVEL No. 46, $15\frac{02}{100}$ CHAINS.
......	19.23	15.02	Foot of lock No. 52, ten-feet lift, northward.
			LEVEL No. 47, $9\frac{23}{100}$ CHAINS.
......	19.37	9.23	Foot of lock No. 53, ten-feet lift, northward.
			LEVEL No 48, $13\frac{38}{100}$ CHAINS.
34	.....	.....	Road bridge (on bents), Yerden...........
......	19.54	13.38	Foot of lock No. 54, ten-feet lift, northward.
			LEVEL No. 49, $16\frac{20}{100}$ CHAINS.
C. 6	.....	14.66	Culvert (arch) ....
......	19.74	1.54	Foot of lock No. 55, ten-feet lift, northward.
			LEVEL No. 50, $9\frac{33}{100}$ CHAINS.
......	19.86	9.33	Foot of lock No. 56, ten-feet lift, northward.
			LEVEL No. 51, $16\frac{63}{100}$ CHAINS.
......	20.07	16.63	Foot of lock No. 57, ten-feet lift, northward.
			LEVEL No. 52, $15\frac{28}{100}$ CHAINS.
.....	20.26	15.28	Foot of lock No. 58 ....
......	.....	.....	Combined locks Nos. 58, 59 and 60, each ten-feet lift, northward ....
......	.....	2.73	Foot of lock No. 60 ....
			LEVEL No. 53, $21\frac{14}{100}$ CHAINS.
......	20.56	21.14	Foot of lock No. 61, ten-feet lift, northward.
			LEVEL No. 54, $21\frac{28}{100}$ CHAINS.
......	20.82	21.28	Foot of lock No. 62, ten-feet lift, northward.
			LEVEL No. 55, $23\frac{20}{100}$ CHAINS.
B. H. 3	.....	12.40	Bulkhead and waste-weir into Lansingkill feeder ....
......	21.11	10.80	Foot of lock No. 63, ten-feet lift, northward.
			LEVEL No. 56, $10\frac{6}{100}$ CHAINS.
......	21.24	10.06	Foot of lock No. 64, ten-feet lift, northward.

of the levels on the Black River canal, etc.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	49$\frac{1}{12}$	1	12$\frac{1}{12}$	....	......	....	1885
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	...	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	.....	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	Lock 60, 1889
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	.....

TABLE No. 4 — (Continued) — *Showing the length*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			LEVEL No. 57, $43\frac{41}{100}$ CHAINS.
35	.....	.....	Diefendorf road bridge (on bents).........
......	21.78	43.41	Foot of lock No. 65, ten-feet lift, northward.
			LEVEL No. 58, $25\frac{32}{100}$ CHAINS.
......	22.10	25.32	Foot of lock No. 66, ten-feet lift, northward.
			LEVEL No. 59, $25\frac{82}{100}$ CHAINS.
......	22.42	25.82	Foot of lock No. 67, ten-feet lift, northward.
			LEVEL No. 60, $8\frac{91}{100}$ CHAINS.
......	22.53	8.91	Foot of lock No. 68, nine-feet lift, northward.
			LEVEL No. 61, $9\frac{1}{100}$ CHAINS.
......	22 64	9.01	Foot of lock No. 69, nine-feet lift, northward.
			LEVEL No. 62, $14\frac{9}{100}$ CHAINS.
36	.....	5.54	Baker road bridge (road Boonville to Rome), stone abutments (Whipple arch) ....
......	22.82	8.55	Foot of lock No. 70, nine-feet lift, northward.
			LEVEL No. 63, $184\frac{61}{100}$ CHAINS.
B. H. 4	.....	10.58	Bulkhead on towpath side (head of Lansingkill feeder) ....
......	.....	.....	Black river railroad bridge, stone abutments.
......	.....	.....	Stringer bridge (on towpath) ....
37	24.16	96.45	Owen's farm bridge (on bents)............
38	24.73	45.43	Turnpike bridge, Boonville, stone abutments (Whipple arch) ....
39	.....	20.64	Black river feeder bridge, wooden bents, tubular arch ....
B. H. 5	.....	7.24	Bulkhead and waste-weir, towpath side, stone abutments.... ....
......	25.13	4.27	Head of lock No. 71, ten-feet lift, southward.
			LEVEL No. 64, $39\frac{83}{100}$ CHAINS.
40	.....	2.40	Main street bridge, Boonville (stone abutments), Whipple arch..... ....
C. 7	.....	4.73	Culvert (arch) ten-feet chord ....
.....	25.63	32.70	Head of lock No. 72, ten-feet lift, southward
			LEVEL No. 65, $55\frac{94}{100}$ CHAINS.
C. 8	.....	5.30	Culvert (arch)............................
41	.....	.....	Farm bridge (on bents)..................
42	.....	.....	Farm bridge (on bents), Jackson..........
.....	26.33	50.64	Head of lock No. 73, ten-feet lift, southward

of the levels on the Black River canal, etc.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	Wood	50	1	$11\frac{9}{12}$	....	......	....	.....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	...	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
Iron ..	.....	$50\frac{3}{12}$	1	$12\frac{11}{12}$	....	......	....	1887
......	.....	......	....	......	....	......	....	....
......	.....	.....	....	......	....	......	....	1889
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	Wood	$51\frac{10}{12}$	1	$11\frac{11}{12}$	....	.....	....	1886
Iron ..	.....	$55\frac{7}{12}$	1	$19\frac{8}{12}$	2	$5\frac{4}{12}$	....	.....
Iron ..	.....	$60\frac{7}{12}$	1	$17\frac{6}{12}$	....	......	....	1882
......	.....	......	....	......	....	......	....	1886
......	.....	......	....	......	....	......	....	.....
Iron ..	.....	$52\frac{7}{12}$	1	18	2	$4\frac{6}{12}$	....	1890
......	.....	......	....	......	....	......	....	...
......	.....	......	....	......	....	......	....	...
......	.....	......	....	......	....	......	....	....
......	Wood	$50\frac{4}{12}$	1	12	....	......	....	....
......	Wood	$40\frac{4}{12}$	1	$12\frac{1}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....

TABLE No. 4—(Continued)—*Showing the length*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			LEVEL NO. 66, $11\frac{96}{100}$ CHAINS.
.....	26.47	11.96	Head of lock No. 74, ten-feet lift, southward
			LEVEL NO. 67, $54\frac{85}{100}$ CHAINS.
43	.....	25.05	Carpenter's farm bridge (on bents), iron chords
.....	27.16	29.80	Lock No. 75, ten-feet lift, southward
			LEVEL NO. 68, $13\frac{7}{100}$ CHAINS.
.....	27.32	13.07	Head of lock No. 76
.....	.....	......	Combined locks Nos. 76, 77, 78 and 79, each ten-feet lift, southward
.....	.....	4.09	Head of lock No. 79
			LEVEL NO. 69, $40\frac{82}{100}$ CHAINS.
44	27.74	29.17	John Jackson's farm bridge (on bents)
.....	27.89	11.65	Head of lock No. 80, nine-feet lift, southward
			LEVEL NO. 70, $11\frac{60}{100}$ CHAINS.
.....	28.03	11.60	Head of lock No. 81
.....	.....	.....	Combined locks Nos. 81, 82, 83 and 84, each nine-feet lift, southward
.....	.....	4.09	Head of lock No. 84
			LEVEL NO. 71, $46\frac{22}{100}$ CHAINS.
.....	.....	2.81	Sugar river feeder
A. 6	.....	2.80	Sugar river aqueduct, stone abutments and piers, wood trunk, three spans forty feet each, piers five feet eleven inches wide
45	28.37	17.14	Randall road bridge, stone abutments, (Whipple arch)
.....	28.66	23.47	Head of lock No. 85, ten-feet lift, southward
			LEVEL NO. 72, $20\frac{29}{100}$ CHAINS.
46	.....	.....	Randall farm bridge (on bents)
......	28.91	20.29	Head of lock No. 86, eleven and one-half feet lift, southward
			LEVEL NO. 73, $14\frac{70}{100}$ CHAINS.
......	29.10	14.70	Head of lock No. 87
......	....	.....	Combined locks Nos. 87, 88, 89 and 90, each ten feet lift, southward
......	.....	4.09	Head of lock No. 90

of the levels on the Black River canal, etc.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	......	......	....	......	....	......	....	....
......	Wood	49	1	$13\frac{4}{12}$	....	......	....	....
......	......	......	....	......	....	......	....	....
......	......	......	....	......	....	......	....	....
......	......	......	....	......	....	......	....	....
......	......	......	....	......	....	......	....	....
......	Wood	$51\frac{1}{12}$	1	$11\frac{11}{12}$	....	......	....	....
......	......	......	....	......	....	......	....	....
......	......	......	....	......	....	......	....	....
......	......	......	....	......	....	......	....	....
......	......	......	....	......	....	......	....	....
......	......	......	....	......	....	......	....	....
......	......	......	....	......	....	......	....	1888 to 1890
Iron ..	......	$50\frac{10}{12}$	1	$15\frac{2}{12}$	....	......	....	....
......	......	......	....	......	....	......	....	....
......	Wood	50	1	$12\frac{1}{12}$	....	......	....	....
......	......	......	....	......	....	......	....	....
......	......	......	....	......	....	......	....	....
......	......	......	....	......	....	......	....	....
......	......	......	....	......	....	......	....	....

TABLE No. 4—(Continued)—*Showing the length*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			LEVEL NO. 74, $13\frac{64}{100}$ CHAINS.
47	.....	3.71	Malcolm farm bridge (on bents)...........
......	29.32	9.93	Head of lock No. 91, ten-feet lift, southward.
			LEVEL NO. 75, $104\frac{67}{100}$ CHAINS.
48	.....	.....	Hulbertville farm bridge (on bents)........
49	.....	.....	David Jones farm bridge (on bents) ....
50	.....	.....	Benj. Jones farm bridge (on bents)........
.....	30.63	104.67	Head of lock No. 92, ten-feet lift southward.
			LEVEL NO. 76, $36\frac{3}{100}$ CHAINS.
51	.....	.....	Cooper farm bridge (on bents)............
52	.....	.....	Denslow farm bridge (on bents)...........
......	31.08	36.03	Head of lock No. 93, ten-feet lift, southward.
			LEVEL NO. 77, $28\frac{41}{100}$ CHAINS.
53	.....	.....	Jones farm bridge (on bents) ....
......	31.43	28.41	Head of lock No. 94, ten-feet lift, southward.
			LEVEL NO. 78, $96\frac{91}{100}$ CHAINS.
B. H. 6	.....	6.72	Bulkhead and spillway (stone abutments)...
C. 9	.....	.....	Arch culvert............................
54	.....	.....	Post farm bridge (on bents) ....
55	.....	.....	Fogarty farm bridge (on bents) ....
56	32.27	59.99	Main street bridge, Port Leyden, stone abutments (Whipple arch) ....
57	.....	.....	North St. bridge, Pt. Leyden, stone abut'mt.
......	.....	.....	Gere's railroad swing bridge (private).......
......	32.64	30.20	Head of lock No. 95, ten-feet lift, southward.
			LEVEL NO. 79, $27\frac{64}{100}$ CHAINS.
C. 10	.....	4.59	Box culvert............................
......	32.99	23.05	Head of lock No. 96, ten-feet lift, southward.
			LEVEL NO. 80, $14\frac{7}{100}$ CHAINS.
......	33.16	14.07	Head of lock No. 97, ten-feet lift, southward.
			LEVEL NO. 81, $19\frac{97}{100}$ CHAINS.
58	.....	.....	Change-bridge, stone abutments...........
C. 11	.....	.....	Box culvert ....
......	33.41	19.97	Head of lock No. 98, ten-feet lift, southward.
			LEVEL NO. 82, $35\frac{87}{100}$ CHAINS.
59	.....	17.81	Road bridge, stone abutments, iron chords..
......	33.86	18.06	Head of lock No. 99....................

of the levels on the Black River canal, etc.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	Wood	$49\frac{11}{12}$	1	$12\frac{2}{12}$	....	......	....	....
......	.....	......	....	......	...	......	....	....
......	Wood	$50\frac{6}{12}$	1	$11\frac{11}{12}$	....	......	....	....
......	Wood	$51\frac{2}{12}$	1	$11\frac{11}{12}$	....	......	....	....
......	Wood	$50\frac{5}{12}$	1	$11\frac{1}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$50\frac{5}{12}$	1	12	....	......	....	....
......	Wood	$50\frac{3}{12}$	1	12	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$49\frac{2}{12}$	1	$11\frac{11}{12}$	....	......	....	.....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$50\frac{4}{12}$	1	$11\frac{11}{12}$	....	......	....	....
......	Wood	50	1	$11\frac{11}{12}$	....	......	....	....
Iron ..	.....	$52\frac{6}{12}$	1	$18\frac{11}{12}$	2	$5\frac{6}{12}$	....	1889
Iron ..	.....	$49\frac{4}{12}$	1	19	2	6	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	.....	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	49	1	$13\frac{8}{12}$	....	.. ...	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	$52\frac{1}{12}$	1	$16\frac{11}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....

TABLE No. 4—(Continued)—*Showing the length*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			LEVEL NO. 82—(*Continued*).
......	.....	.....	Combined locks Nos. 99 and 100, each ten-ft. lift, & 101, ten and one half-ft. lift, southw'd.
......	.....	2.73	Head of lock No. 101 ....
			LEVEL NO. 83, $11\frac{27}{100}$ CHAINS.
60	.....	.....	Philo Post's farm bridge (on bents) ....
......	34.04	11.27	Head of lock No. 102, ten and one-quarter-feet lift, southward....................
			LEVEL NO. 84, $87\frac{44}{100}$ CHAINS.
......	.....	....	(This is the river level above Lyon's Falls dam; towing-path follows the west bank for a distance of $44\frac{69}{100}$ chains, to the side-cut around the falls).................
......	.....	54.08	Tow path bridge (stringers) ....
61	35.02	24.46	Road and change-bridge, stone abutments (Whipple arch) ....
......	35.13	8.90	Head of lock No. 103....................
......	.....	.....	Combined locks No. 103, four-feet lift, and Nos. 104 and 105, each ten-feet lift, southward ....
......	.....	2.73	Head of lock No. 105.................
			LEVEL NO. 85, $17\frac{16}{100}$ CHAINS
62	.....	5.31	Lyon's Falls road bridge, stone abutments, (Whipple arch) ....
......	35.38	11.85	Head of lock No. 106....................
......	.....	.....	Combined locks Nos. 106 and 107, each eleven-feet lift, southward..............
......	.....	1.36	Head of lock No. 107.................. .
			LEVEL NO. 86, $7\frac{54}{100}$ CHAINS.
B. H. 7	....	4.25	Bulkhead and waste weir on tow path side.
63	.....	1.49	Cart road bridge (on bents) ....
......	35.49	1.80	Head of lock No. 108....................
......	.....	.....	Combined locks Nos. 108 and 109, each twelve-feet lift, southward ....
.....	35.52	2.73	Foot of lock No. 109 ....

of the levels on the Black River canal, etc.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	....	......	....	......	....	....
......	.....	......	....	.....	....	......	....	....
......	Wood	$51\frac{6}{12}$	1	$12\frac{1}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$52\frac{7}{12}$	1	18	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$51\frac{10}{12}$	1	13	1	$6\frac{6}{12}$	....	1885
......	.....	.....	..	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......		......	....	......	....	......	....	1884
......	Wood	$51\frac{7}{12}$	1	12	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....

TABLE No. 4—(Concluded)—*Showing the length*

Number of structure.	Cumulative distance in miles.	Distances in chains and links.	GENERAL DESCRIPTION.
			The following structures are on the river above lock No. 103:
......	.....	.....	Dam at Lyon's Falls, 491 feet long, built of timber with stone abutments............
......	....	.....	Bridge over Black and Moose rivers at their junction a short distance above the dam..
64	.....	.....	Black river bridge (two spans), iron chord..
65	.....	.....	Moose river bridge (two spans), iron chord..
66	.....	.....	Junction bridge (new), one span, over channel above Black and Moose river bridges.

* East. † West.

of the levels on the Black River canal, etc.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	.....	....	....	....	....	....	...
......	.....	.....	....	....	....	....	....	...
......	Wood	$*89\frac{7}{12}$ †89	1	$17\frac{10}{12}$	....	....	....	1889
......	Wood	$*89\frac{7}{12}$ †91	..	18	....	....	....	1887
......	Wood	$42\frac{8}{12}$	1	‡26 $§14\frac{7}{12}$	..	....	....	...

‡ North. § South.

TABLE No. 4—(Continued)—*Black river*

Number of structure.	GENERAL DESCRIPTION.
	Foot of lock No. 109, Black River canal, at Lyons falls
1	Whittlesey's bridge, east span (Whipple arch)
	Whittlesey's bridge, center span
	Whittlesey's bridge, west span, swing
2	Glendale bridge, east span
	Glendale bridge, center span
	Glendale bridge, west span
	Lock and dam at Otter creek
	Lock and dam at Bush's
3	Beach's bridge, east span, swing
	Beach's bridge, center span
	Beach's bridge, west span swing
4	Illingsworth bridge, first, east span, swing
	Illingsworth bridge, second span, iron chords
	Illingsworth bridge, third span, iron chords
	Illingsworth bridge, fourth, west span, iron chords
4½	Road bridge over Beaver river (two spans) at Naumberg
	Road bridge over Beaver river, east span
	Road bridge over Beaver river, west span
5	Castorland bridge, first, east span
	Castorland bridge, second span
	Castorland bridge, third span (Whipple arch)
	Castorland bridge, fourth, west span, swing
	Rome, Watertown and Ogdensburgh railroad bridge at Carthage, Utica branch, seven spans { 5 2 }
6	Carthage river bridge, first east span (King Bridge Co. arch),
	Carthage river bridge, second span (King Bridge Co. arch)
	Carthage river bridge, third span (King Bridge Co. arch)
	Carthage river bridge fourth span (King Bridge Co. arch)
	Carthage river bridge, fifth span (King Bridge Co. arch)
	Carthage river bridge, sixth span (King Bridge Co. arch)
	Carthage river bridge, seventh span (King Bridge Co. arch)
	Dam at Carthage

improvement from Lyons Falls to Carthage.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks.	Skew.	Perishable parts renewed.
......	.....	......	....	......	....	......	....	....
Iron ..	.....	$56\frac{6}{12}$	1	17	....	......	....	1879
......	Wood	$75\frac{4}{12}$	1	$17\frac{4}{12}$	....	......	....	....
......	Wood	$48\frac{8}{12}$	1	$14\frac{1}{12}$	....	......	....	1879
......	Wood	$90\frac{7}{12}$	1	$16\frac{11}{12}$	....	......	....	....
......	Wood	$90\frac{3}{12}$	1	$16\frac{11}{12}$	....	......	....	....
......	Wood	50	1	$13\frac{7}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1885
......	Iron .	$49\frac{8}{12}$	1	$13\frac{2}{12}$	....	......	....	....
......	Wood	$67\frac{6}{12}$	1	18	....	......	....	....
......	Wood	$67\frac{9}{12}$	1	18	....	......	....	....
......	Wood	48	1	$14\frac{9}{12}$	....	......	....	....
......	Wood	$69\frac{4}{12}$	1	$18\frac{1}{12}$	....	......	....	....
......	Wood	$69\frac{7}{12}$	1	$18\frac{1}{12}$	....	......	....	....
......	Wood	$68\frac{4}{12}$	1	$18\frac{1}{12}$		......	....	....
......	.....	......	....	......	....	......	....	....
......	Wood	64	1	17	....	......	....	1885
......	Wood	$60\frac{10}{12}$	1	17	....	......	....	1885
......	Wood	$81\frac{8}{12}$	1	$16\frac{11}{12}$	...	......	....	....
......	Wood	$80\frac{5}{12}$	1	$16\frac{11}{12}$	....	......	....	....
Iron ..	.....	$84\frac{1}{12}$	1	18	....	......	....	....
......	Iron .	$50\frac{2}{12}$	1	$13\frac{6}{12}$	....	......	....	1888
		{ 70	1	$15\frac{5}{12}$	}			
......	.....	{ 80	1	$15\frac{5}{12}$	} ..	......	....	....
Iron ..	.....	$49\frac{9}{12}$	1	$17\frac{2}{12}$	1	$5\frac{8}{12}$	....	1879
Iron .	.....	$67\frac{8}{12}$	1	$17\frac{2}{12}$	1	$5\frac{8}{12}$	....	1879
Iron ..	.....	$67\frac{8}{12}$	1	$17\frac{2}{12}$	1	$5\frac{8}{12}$	....	1879
Iron ..	.....	$72\frac{6}{12}$	1	$17\frac{2}{12}$	1	$5\frac{8}{12}$	....	1879
Iron ..	.....	$72\frac{1}{12}$	1	$17\frac{2}{12}$	1	$5\frac{8}{12}$	....	1879
Iron ..	.....	$67\frac{10}{12}$	1	$17\frac{2}{12}$	1	$5\frac{8}{12}$	....	1879
Iron ..	.....	$35\frac{1}{12}$	1	$17\frac{2}{12}$	1	$5\frac{8}{12}$	....	1879
......	.....	......	....	......	....	......	....	....

TABLE No. 4—(Continued)—*Delta feeder enters*

Number of structure.	Miles from canal.	GENERAL DESCRIPTION.
1	0.02	Road bridge at mouth of feeder (stringer) ....
2	0.66	Walworth's farm bridge (on bents) ....
3	1.02	Ela road bridge (on bents)......................
......	1.07	Culvert ....
4	1.35	Dougal farm bridge (stringer) near lock ....
......	1.40	Guard and lift-lock at head of feeder..............
5	.....	Bridge across Mohawk river (two spans) three chains below lock ....
......	.....	Crib dam across the Mohawk river, 234 feet long, $6\frac{50}{100}$ chains below lock.......................

Lansingkill feeder — This feeder turns the surplus water of the Black River singkill and Mohawk river into

Number.	Miles.	GENERAL DESCRIPTION.
......	.....	Bulkhead 10.58 chains north of lock No. 70, Black River canal................................
......	0.89	Bridge ....
......	1.44	Bridge ....
......	1.61	Bridge ....
......	2.00	Ends at Lansingkill Falls.........................

Forestport feeder enters canal 11.51

Number of structure.	Miles from canal.	GENERAL DESCRIPTION.
1	.....	Manchester farm bridge (truss on bents)...........
2	0.82	Irvin road bridge (truss on bents) ....
B. H. 1	1.00	Pitcher bulkhead and spillway, towpath side ......
3	1.26	Roberts road bridge (truss on bents)..............
4	1.42	Pitcher road bridge (truss on bents) ....
5	2.11	Bonfield road bridge (truss on bents) ....
6	3.21	Hawkinsville road bridge (stone abutments) ....
7	3.94	Lobdell road bridge (truss on bents) ....
C. 1	4.49	Slocum culvert ....

canal seventy-five feet north of Mohawk aqueduct.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	$18\frac{8}{12}$	1	$15\frac{8}{12}$	....	......	....	....
......	Wood	$40\frac{8}{12}$	1	$11\frac{10}{12}$	....	......	....	....
......	Wood	40	1	$11\frac{10}{12}$	....	.....	....	....
......	.....	......	....	......	....	......	....	....
......	.....	$16\frac{5}{12}$	1	$15\frac{10}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	1886

canal into the Lansingkill, near lock No. 70, and thence through the Lan- the Erie canal at Rome.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	....

chains south of lock No. 71.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	Wood	$49\frac{10}{12}$	1	$11\frac{11}{12}$	....	......	....	....
......	Wood	$48\frac{5}{12}$	1	$16\frac{6}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	1882
......	Wood	$48\frac{11}{12}$	1	$12\frac{1}{12}$	....	......	....	....
......	Wood	$49\frac{8\frac{1}{2}}{12}$	1	$13\frac{11}{12}$	....	......	....	....
......	Wood	$48\frac{10}{12}$	1	$12\frac{4}{12}$	....	......	....	....
Iron ..	.....	$50\frac{1}{12}$	1	17	....	......	....	1886
......	Wood	$46\frac{8\frac{1}{2}}{12}$	1	$12\frac{1}{12}$	....	......	....	....
......	.....	......	....	......	....	......	....	....

TABLE No. 4—(Concluded)—*Forestport feeder*

Number of structure.	Miles from canal.	GENERAL DESCRIPTION.
8	.....	Slocum farm bridge (truss on bents)
BH. 2	4.72	Lee bulkhead, on berme side
C. 2	4.75	Lee culvert
9	5.08	Lee road bridge (truss on bents)
10	.....	Town road bridge (truss on bents)
BH. 3	.....	Evans' bulkhead
11	.....	Courtney road bridge (truss on bents)
C. 3	.....	Culvert
BH. 4	9.39	Williams' bulkhead, near Forestport, tow-path side
12	.....	Dutch Hill road bridge
......	9.67	Guard-lock at entrance into pond
13	9.69	Road bridge (stone abutments), crosses directly over the guard-lock (iron chords)
......	.....	Forestport dam, 7 chains below feeder
		SUGAR RIVER FEEDER.
		Enters canal 1.25 chains north of lock No. 84.
......	0.14	Bulkhead and dam
		RESERVOIRS SUPPLYING FORESTPORT FEEDER.
......	9.67	Guard-lock at head of feeder
......	Approx. 11.0	Head of pond
......	19½	White lake, dam and bulkhead
......	22	Chub lake, dam and bulkhead
......	27½	Sand lake, dam and bulkhead
Feed into Sand lake.	30	Third Bisby lake, bulkhead
	30¼	Dam at Old Outlet, Third Bisby lake
	31	Second and first Bisby lakes, dam and bulkhead
	29½	Woodhull reservoir, dam and well-house, waste-weir and tender's house
......	33½	Twin lakes, dam and bulkhead
......	32½	North lake, dam and well-house and tender's house
......	38½	Canachagala lake, bulkhead (feeds into North lake).
......	36	South lake, dam and well house
......	.....	Old Forge dam and bulkhead, Fulton chain
......	.....	Sixth lake, dam and bulkhead
......	.....	Beaver River reservoir dam and bulkhead
		CHEMUNG CANAL.
......	.....	One iron swing-bridge at Watkins One pier, three breakwaters, one light-house

enters canal 11.51 *chains south of lock No.* 71.

Arch truss.	Trapezoidal truss.	Clear span of bridge.	Number of roadways.	Width of roadways on centers.	Number of sidewalks.	Width of sidewalks on centers.	Skew.	Perishable parts renewed.
......	Wood	$49\frac{8\frac{1}{2}}{12}$	1	$11\frac{11}{12}$	....	......	....	.....
......	.....	......	....	......	....	......	....	1887
......	.....	......	....	......	....	......	....	.....
......	Wood	$49\frac{11\frac{1}{2}}{12}$	1	$13\frac{6}{12}$	....	......	....	1870
......	Wood	$40\frac{4}{12}$	1	$11\frac{6}{12}$	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	Wood	$49\frac{4}{12}$	1	$11\frac{11}{12}$	....	....	....	1886
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	1886
......	Wood	$49\frac{11}{12}$	1	$13\frac{6}{12}$	....	......	....	.....
......	.....	......	...	......	....	......	......	.....
......	Wood	$52\frac{5}{12}$	1	$14\frac{10}{12}$	....	......	....	1885
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	....
......	.....	......	....	......	....	......	....	.....
......	.....	......	....	......	....	......	....	1887
......	.....	......	....	......	....	......	....	1887
......	.....	......	....	......	....	......	....	1861
......	.....	......	....	......	....	......	....	1890
......	.....	......	....	......	....	......	....	1884 1882
......	.....	......	....	......	....	......	....	1890
......	.....	......	....	......	....	......	....	1861
......	.....	......	....	......	....	......	....	1890
......	.....	......	....	......	....	......	....	1880
......	.....	......	....	......	....	......	....	1886
....	Iron plate girder	.....	1	18	2	5	....	1890

SUMMARY.

ERIE CANAL.

	Miles.
Total length of Erie canal on middle division	$97\frac{2}{100}$
Navigable feeders	$3\frac{54}{100}$
Total	$100\frac{56}{100}$

	Feet.
Ascending lockages, eastward	$44\frac{70}{100}$
Ascending lockages, westward	$10\frac{872}{1000}$
Surface of Frankfort level, above tide-water	$425\frac{4}{10}$
Surface of Montezuma level, above tide-water	$392\frac{571}{1000}$

The structures are:

Main Line.

Twelve aqueducts (aggregating sixty-seven spans).

Ninety-eight street and road bridges, classified as follows:

Three wrought-iron lift-bridges, one roadway, two sidewalks.

One wrought-iron swing-bridge, one roadway, two sidewalks.

One wrought-iron trapezoidal (Simms), iron needle-beams, two roadways, two sidewalks.

One wrought-iron arch, iron needle-beams, two roadways, two sidewalks.

Three cast-iron arches, iron needle-beams, two roadways, two sidewalks.

One cast-iron arch, wooden needle-beams, two roadways, two sidewalks.

One Bollman truss, wooden needle-beams, two roadways, no sidewalks.

One wrought-iron trapezoidal, iron needle-beams, one roadway, two sidewalks.

Eighteen cast-iron arch, iron needle-beams, one roadway, two sidewalks.

Six cast-iron arch, wooden needle-beams, one roadway, two sidewalks.

One cast-iron suspended arch, wooden needle-beams, one roadway, two sidewalks.

One Bollman truss, wooden needle-beams, one roadway, two sidewalks.

Two cast-iron arch, iron needle-beams, one roadway, one sidewalk.

One cast-iron arch, wooden needle-beams, one roadway, one sidewalk.

One wrought-iron arch, iron needle-beams, one roadway, no sidewalk.

Seventeen cast-iron arch, iron needle-beams, one roadway, no sidewalk.

One tubular cast-iron arch, iron needle-beams, one roadway, no sidewalk.

One wrought-iron trapezoidal, iron needle-beams, one roadway, no sidewalk.

Three cast-iron arch, wooden needle-beams, one roadway, no sidewalks.

One wooden trapezoidal; wooden chord, two roadways, no sidewalks.

Twenty-two wooden trapezoidal, wooden chord, one roadway, no sidewalks.

Eleven wooden trapezoidal, iron chords, one roadway, no sidewalks.

Three wooden trapezoidal, road and change-bridges, wooden chords one roadway, no sidewalks.

One stone arch, one roadway, one sidewalk.

Seventeen farm bridges, classified as follows:

Five wooden trapezoidal, iron chords, one roadway, no sidewalks.

Twelve wooden trapezoidal, wooden chords, one roadway, no sidewalks.

Two change-bridges, classified as follows:

One tubular trapezoidal, iron needle-beams, one roadway, no sidewalks.

One wooden trapezoidal, wooden chord, one roadway, no sidewalk.

Eight tow-path bridges, classified as follows:

One wooden swing.

Two cast-iron trapezoidal, tubular.

One cast-iron arch, tubular.

Four stringer.

Six foot-bridges, classified as follows:

One wrought-iron plate girder, iron needle-beams, one walk.

Two wrought-iron trapezoidal, iron needle-beams, one walk.

Two cast-iron trapezoidal, tubular, iron needle-beams, one walk.

One wooden trapezoidal, iron chord, wooden needle-beams, one walk.

One cast-iron arch bridge, carrying salt mains, iron needle-beams.

Eighteen railroad bridges, classified as follows:

Two wrought-iron plate girder swing-bridges, one track.

Two wrought-iron riveted swing-bridges, one track.

Five wrought-iron riveted over bridge, two tracks.

Three wrought-iron pin-connected over bridges, two tracks.

Three wrought-iron pin-connected over bridges, one track.

Three wrought-iron riveted over bridges, one track.

One private farm bridge, wooden trapezoidal, iron chords, one roadway.

Ten private foot bridges, classified as follows:
  Three wrought-iron trapezoidal, iron needle-beams, one walk.
  Two wooden trapezoidal, wooden chords, one walk.
  Five suspension, wooden needle-beams, one walk.

One private wrought-iron, trapezoidal, iron needle-beams, carrying Syracuse Steam Heat and Power Company's pipes.

One cast-iron arch, carrying Solway Process Company's salt mains.

Three bulkheads, waste-weirs and spillways.

Eight bulkheads and waste-weirs.

Seventy-eight culverts, classified as follows:
  Thirty-five arch.
  Forty-one composite.
  Two box.

Seven lift-locks.

One weigh-lock.

Two weigh-locks and office buildings.

Two receivers.

One stop-gate and bulkhead, tumble-gate, stone abutments.

One weigh-lock sewer, stone.

Three city sewers, cast pipe.

Two stone spillways.

One railroad tunnel, two arches.

Feeders and reservoirs.

Nineteen artificial feeders (three navigable).

Ten natural feeders.

One aqueduct.

Thirty-four road and street bridges, classified as follows:
  One wrought-iron deck, one roadway, one sidewalk.
  One cast-iron arch, one roadway, two sidewalks.
  Three cast-iron arch, one roadway, no sidewalks.
  Nineteen wooden trapezoidal, wooden chord, one roadway, ten stringers.

Twenty-seven farm bridges.

Seven trapezoidal, wooden chord, one roadway, twenty stringers.

One stringer tow-path bridge.

One plate girder railroad bridge, four tracks.

Twenty-four bulkheads.

Eight culverts.

Twenty-two river and creek dams.

Eleven reservoir dams.
Four guard-gates.
Ten stone overfalls.
One iron pipe.
One receiver.
Three spillways.
Eight well-houses.

OSWEGO CANAL.

	Miles.
Length of main line	$37\frac{78}{100}$
Side-cuts	$2\frac{86}{100}$
River improvements	$37\frac{58}{100}$
Total	$78\frac{22}{100}$

	Feet.
Ascending lockages, southward, main line (approximate)	$154\frac{528}{1000}$
Ascending lockages, eastward, Oneida river improvement	6
Ascending lockages, westward, Baldwinsville side-cut	10

	Feet+T. W.
Surface of Syracuse level	$400\frac{696}{1000}$
Surface, Lake Ontario (approximate)	243
Surface, Seneca river at Three Rivers (approximate)	358
Surface, Oneida lake (approximate)	365
Surface, Seneca river at Cold Spring (approximate)	$358\frac{516}{1000}$
Surface, Seneca river above Baldwinsville dam (approximate)	370

The structures are:

Main Line.

One aqueduct.

Twenty-three street and road bridges, classified as follows:

One wrought-iron lift-bridge, one roadway, two sidewalks.
Two cast-iron arch, iron needle-beams, two roadways, two sidewalks.
Seven cast-iron arch, one roadway, two sidewalks.
One cast-iron trapezoidal, one roadway, two sidewalks.
One cast-iron arch, one roadway, one sidewalk.
Three cast-iron arch, one roadway, no sidewalks.
Five wooden trapezoidal, iron-chord, one roadway, no sidewalks.
Three wooden trapezoidal, wooden chord, one roadway, no sidewalks.

Four road and change-bridges, classified as follows:

One cast-iron tubular arch, iron needle-beams, one roadway, no sidewalks.
One wooden trapezoidal, wooden chord, two roadways, no sidewalks.

- One cast-iron arch, iron needle-beams, two roadways, no sidewalks.
- One wooden trapezoidal, wooden chords, three roadways, no sidewalks.
- One towpath and road bridge, six spans, wooden chords, one roadway, no sidewalks.

Six change bridges, classified as follows:

- One cast-iron trapezoidal, one roadway.
- One wooden trapezoidal, iron chord, one roadway.
- Four wooden trapezoidal, wooden chord, one roadway.

One wrought-iron plate girder foot bridge, one walk.
One wooden trapezoidal, carrying salt mains, one track.
One towpath bridge stringer, one roadway.
Two private wrought-iron arch road bridges, one roadway.
Three private foot-bridges, classified as follows:

- One trapezoidal, wrought-iron, one walk.
- Two trapezoidal, wooden, one walk.

Five railroad bridges, classified as follows:

- One wrought-iron lift, two tracks.
- One wrought-iron lattice, two tracks.
- One wrought-iron plate girder swing, one track.
- Two wrought-iron pin connected (over), one track.

Eleven bulkheads.
Six culverts, classified as follows:

- One arch.
- Five composite.

Seven stone dams.
Seventeen lift-locks.
Six guard-locks (one used only as a stop-gate).
One connecting lock at Fulton.
One weigh lock (not used).
Three sluices, stone abutments.
Forty-nine sluices, wooden abutments.
Nine spillways.
Three State shops.
Three river walls.
One inlet to salt works

Salina and Liverpool side-cuts.

Eight street bridges, classified as follows:

- One cast-iron arch, iron needle-beams, one roadway, no sidewalks.
- One cast-iron trapezoidal, one roadway, no sidewalks.
- Four wooden trapezoidal, wooden chords, one roadway, no sidewalks.
- Two stringer, one roadway, no sidewalks.

One wooden swing-bridge at Salt Blocks, Liverpool, one roadway, no sidewalks.

One stone lock.

One waste-weir.

Onondaga outlet, Seneca river towing-path, side-cut and Jack's reefs.

Six street bridges, classified as follows:

- One wrought-iron, arch, iron needle-beams, one roadway, two sidewalks.
- Two cast-iron, arch, one roadway, no sidewalks.
- Three wooden swings, one roadway, no sidewalks.

One float bridge (towing-path), one roadway.

One wooden railroad swing-bridge, one track, one sidewalk.

One crib dam.

One guard-gate, stone abutments.

One wooden lock.

Oneida river improvement.

Three road bridges, classified as follows:

- One iron swing.
- Two wooden swings.

One wooden Howe-truss railroad bridge.

One swing railroad bridge.

One crib dam.

One tree dam.

Two steamboat locks.

CAYUGA AND SENECA CANAL.

	Miles.
Length of main line	$20\frac{88}{100}$
Length of Cayuga branch	$2\frac{11}{100}$
Length of Ithaca inlet	$2\frac{5}{100}$
Length of Seneca lake outlet	$0\frac{17}{100}$
Total	$25\frac{21}{100}$

	Feet.
Ascending lockages westward, main line	$63\frac{58}{100}$
Ascending lockages eastward, main line	13
Ascending lockages eastward, Cayuga branch	10

	Feet + T. W.
Surface of Montezuma level	$392\frac{571}{1000}$
Surface of Cayuga lake	$379\frac{571}{100}$
Surface of Seneca lake (approximate)	445

The structures are, including branches, etc., eighteen street and road bridges, classified as follows:

- Three cast-iron arch, iron needle-beams, two roadways, two sidewalks.
- One wrought-iron trapezoidal, iron needle-beams, one roadway, two sidewalks.
- Six cast-iron arch, iron needle-beams, one roadway, no sidewalks.
- One wooden swing, Cayuga, one roadway, no sidewalks.
- Four wooden trapezoidal, wooden chords, one roadway, no sidewalks.
- Three iron swing, Ithaca inlet, one roadway, two sidewalks.

Two road and change-bridges, classified as follows:

- One cast-iron arch, iron needle-beams, two roadways, no sidewalks.
- One cast-iron trapezoidal, tubular, one roadway, no sidewalks.
- One wooden trapezoidal farm bridge, wooden chords, one roadway, no sidewalks.
- One wooden trapezoidal, change-bridge, wooden chords, one roadway, no sidewalks.

Fourteen tow-path bridges, classified as follows:

- One wooden draw-bridge, one roadway.
- Five wooden trapezoidal (aggregating twenty spans), one roadway.
- Two wooden pile bents (aggregating twenty-six spans), one roadway.
- Six stringer (aggregating eight spans), one roadway.

Four railroad bridges, classified as follows:

- One wrought-iron lift, one track.
- One wrought-iron lattice, over, one track.
- One wrought-iron pin connected, over, one track.
- One wooden, Howe-truss, over, one track.

One private trussed, carrier bridge, iron.

Nine culverts, composite.

Four dams, classified as follows:

- Two stone.
- One crib.
- One rip-rap.

Eleven lift-locks.

Twenty-one wooden sluices.

Three spillways.

One waste-weir.

Four piers.

Two breakwaters.

Two light-houses.

CHEMUNG CANAL.

Lake level, 2$\frac{58}{100}$ miles long.

The structures are:

One wrought-iron plate girder swing-bridge, one roadway, two sidewalks.

One cast-iron arch-bridge (old canal), one roadway, two sidewalks.

One pier.

Three breakwaters, Watkins Harbor.

BLACK RIVER CANAL.

	Miles.
Length Rome to Lyons Falls	35$\frac{52}{100}$
Length river improvement	42$\frac{50}{100}$
Length navigable feeders	12$\frac{69}{100}$
Total	90$\frac{71}{100}$

	Feet.
Ascending lockages (canal) northward	693
Ascending lockages (canal) southward	387$\frac{25}{100}$
Ascending lockages (river) southward (approximate)	9

	Feet + T. W.
Surface of Rome level	428$\frac{4}{10}$
Surface of Summit level	1,121$\frac{4}{10}$
Surface of river at Lyons Falls	734$\frac{15}{100}$
Surface of river at Carthage (approximate)	722

The structures are (main canal):

Six aqueducts, aggregating twenty-four spans.

Twenty-seven street and road bridges, classified as follows:

- One cast-iron arch, iron needle-beams, two roadways, two sidewalks.
- Three cast-iron arch, iron needle-beams, one roadway, two sidewalks.
- One wrought-iron trapezoidal, iron needle-beams, one roadway, two sidewalks
- Three cast-iron arch, wooden needle-beams, one roadway, two sidewalks.
- One cast-iron arch, iron needle-beams, one roadway, one sidewalk.
- One cast-iron arch, wooden needle-beams, one roadway, one sidewalk.
- Four cast-iron arch, iron needle-beams, one roadway, no sidewalks.
- One cast-iron tubular arch, wooden needle-beams, one roadway, no sidewalk.
- One wooden trapezoidal, iron chord, one roadway, one sidewalk.
- Two wooden trapezoidal, iron chord, one roadway, no sidewalks.

Nine wooden trapezoidal, wooden chord, one roadway, no sidewalks.
Two wooden trapezoidal road and change-bridges, wooden chords, one roadway, no sidewalks.
One cast-iron arch road and change-bridge, wooden needle-beams, one roadway, no sidewalk.

Thirty farm bridges, classified as follows:
Three wooden trapezoidal, iron chords, one roadway.
Twenty-seven wooden trapezoidal, wooden chords, one roadway.

One wooden trapezoidal change-bridge, wooden chords, one roadway.
One tubular cast-iron arch tow path bridge, one roadway.
Two stringer tow path bridges, one roadway.
One railroad swing-bridge, one track.
One railroad truss-bridge, over, one track.
One private farm bridge, wooden trapezoidal, iron chords, one roadway.
Five bulkheads and waste-weirs.
Three spillways.

Eleven culverts, classified as follows:
Eight arch.
One composite.
Two box.

Two dams, wooden, with stone abutments.
One hundred and nine locks.
One stone sluice.

BLACK RIVER IMPROVEMENT.

Five river bridges, with a swing span in each (aggregating four iron and thirteen wooden spans), one roadway, each.
One wrought-iron river bridge, seven spans, one roadway, one sidewalk.
One wooden road bridge (Beaver river), two spans, one roadway.
Three bridges at junction of Black and Moose rivers, wood, five spans.
One railroad bridge.
Two wooden steamboat locks.
Three dams.

Delta feeder.

One bridge across Mohawk river at Delta, two spans.
One wooden truss road bridge.
One stringer road bridge.
One wooden truss farm bridge.
One stringer farm bridge.
One wooden dam.
One guard-lock.

Lansingkill feeder.

Three wooden stringer bridges.
One bulkhead.

Forestport feeder.

One cast-iron arch road bridge, one roadway.
Ten wooden trapezoidal road bridges, one roadway.
Two wooden trapezoidal farm bridges, one roadway.
Three bulkheads.
One bulkhead and spillway.
Three culverts.
One dam.
One guard-lock.

Sugar River feeder.

One bulkhead.
One dam.

Reservoirs for Forestport feeder.

Seven bulkheads and waste-wiers.
Nine dams.
Two tenders' houses.
Three well-houses.
One waste-weir.

Black river and Beaver river reservoirs.

Three bulkheads.
Three dams.

TABLE No. 5.

MIDDLE DIVISION — NEW YORK STATE CANALS.

List of benches, showing elevation above canal bottom and above tide water.

NOTE — Benches are marked by a copper plug, flush with the top of the stone, except as otherwise noted.

Number.	DESCRIPTION.	Elevation above C. B.	Elevation above T. W.
	ERIE CANAL — FRANKFORT LEVEL — ELEVATION OF C. B. 418.400 + T. W.		
1	Green's road bridge, East Utica, southeast corner, lower step, east wing tow-path abutment	13.638	432.038
2	Starch factory bridge, southwest corner of bridge, east tow-path abutment (not marked)	17.063	435.463
3	Clay street bridge, Utica, northwest corner, west wing tow-path abutment, on stone under sloping coping	12.393	430.793
4	Ballou water-weir, west end of bulkhead wall	8.495	426.895
5	Utica weigh-lock, northwest corner, top of base of fourth column from east end (not marked)	11.156	429.556
6	Genesee street bridge, Utica, second step, east wing tow-path abutment	10.820	429.220
7	Seneca street bridge, Utica, lower step, west wing tow-path abutment	11.986	430.386
8	Broadway foot bridge, Utica, southwest corner of stone at foot of west stairs, tow-path side	9.274	427.674
9	Whitesboro street bridge, Utica, fourth step, west wing tow-path abutment	13.148	431.548
10	Lock No. 46, northeast hollow quoin, tow-path lock (between anchors) lift of lock No. 46, three feet westward	12.038	430.438
	ROME LEVEL — ELEVATION OF C. B. 421.400 + T. W.		
11	Platt street foot bridge, Utica, lower step, east wing tow-path abutment	11.020	432.420
12	Whitesboro road bridge, lower step, east wing tow-path abutment	11.574	432.974
13	Yorkville road bridge, lower step, east wing tow-path abutment	12.872	434.272

14	Sauquoit aqueduct, second coping stone from end of east wing, parapet wall	12.046	433.446
15	Clinton street bridge, Whitesboro, lower step, west wing tow-path abutment...	12.198	433.598
16	Westmoreland street bridge, Whitesboro, lower step, east wing tow-path abutment.	11.242	432.642
17	Bradley road bridge, coping of buttress, east wing tow-path abutment............	13.901	436.301
18	Evans farm bridge, lower step, east wing, tow-path abutment....................	12.528	433.928
19	Oriskany aqueduct, southwest corner, coping of parapet, end of west wing	12.441	433.841
20	Brainard's farm bridge, lower step, west wing tow-path abutment	11.177	432.577
21	Parkhurst's farm bridge, lower step, east wing, tow-path abutment...............	12.251	433.651
22	Kirley's farm bridge, lower step, west wing, tow-path abutment	13.503	434.903
23	Murphy's road bridge, lower step, east wing, tow-path abutment..................	13.330	434.730
24	Waste-weir No. 2 (near Clark's farm bridge), east end of parapet coping..........	11.440	432.840
25	Stanwix road bridge, second step, east wing, tow-path abutment..................	15.189	436.589
26	Mohawk feeder, Rome, southwest corner, west wing of culvert under towing-path...	11.839	433.239
27	Ethridge & Fuller's store (near — west of — James street, Rome), southeast corner east window sill in rear of store (not marked)	14.853	436.253
28	Barnes' farm bridge, lower step, east wing, tow-path abutment	13.516	434.916
29	Brainard's farm bridge, second step, west wing, tow-path abutment	15.557	436.957
30	Fort Bull waste-weir, near west end coping of parapet wall	11.315	432.715
31	Armstrong's farm bridge, lower step, west wing, tow-path abutment...............	13.644	435.044
32	Herrig's farm bridge, lower step, east wing, tow-path abutment	13.648	435.048
33	Sands' farm bridge, lower step, east wing, tow-path abutment....................	14.212	435.612
34	Tuttles, farm bridge, lower step, east wing, tow-path abutment..................	13.724	435.124
35	Main street bridge, New London, lower step, east wing, tow-path abutment........	13.661	435.061
36	Grove Spring road bridge, west stone under berme bent back of front timber.	7.858	429.258
37	Stacy's Basin road bridge, lower step, east wing, tow-path abutment..............	13.973	435.373
38	Happy Valley road bridge, lower step, east wing, tow-path abutment..............	13.814	435.214
39	East road bridge, Higginsville, second step, east wing, tow-path abutment.........	10.155	431.555
40	West road bridge, Higginsville, second step, west wing, tow-path abutment........	10.166	431.566
41	Dunbarton road bridge, second step, east wing, tow-path abutment................	10.319	431.719
42	Durkee's road bridge, third step, east wing, tow-path abutment..................	10.970	432.370
43	State road bridge, third step, east wing, tow-path abutment.....................	11.097	432.497

TABLE 5 — MIDDLE DIVISION — ERIE CANAL — *List of benches, etc.*— (Continued.)

Number.	DESCRIPTION.	Elevation above C. B.	Elevation above T W.
	ERIE CANAL — ROME LEVEL — (Continued).		
44	Culvert No. 34 (one mile west of State bridge), northeast corner, east end of parapet coping	7.073	428.473
45	East road bridge, Durhamville, third step, west wing, tow-path abutment	12.255	433.655
46	Main street bridge, Durhamville, third step, east wing, tow-path abutment	11.152	432.552
47	Bennett's road bridge, Durhamville, lower step, west wing, tow-path abutment	11.611	433.011
48	Shollhammer's road bridge, second step, east wing, berme abutment	12.771	434.171
49	Cowassalon aqueduct, near center of east face of coping of buttress, east wing, tow-path side	8.741	430.141
50	Lenox basin road bridge, second step, west wing, tow-path abutment	10.556	431.956
51	Culvert No. 39 (one mile west of Lenox basin), coping of parapet over face of east wing.	6.595	427.995
52	Peterboro street bridge, Canastota, fourth step, east wing, tow-path abutment	12.414	433.814
53	Culvert No. 42 (at cider mill, Canastota), northeast corner coping of parapet	7.700	429.100
54	Beebe's road bridge, fourth step, east wing, tow-path abutment	11.580	432.980
55	Culvert No. 43 (one-quarter mile west of Beebe's road), center of coping, tow-path parapet	7 434	428.834
56	Culvert No. 44 (near Fuller's road), coping tow-path parapet	7.429	428.829
57	New Boston road bridge, fourth step, east wing, tow-path abutment	11.944	433.344
58	Canasaraga culvert No. 45, west end, coping of parapet	5.717	427.117
59	Canasaraga road bridge, fourth step, east wing, tow-path abutment	11.996	433.396
60	Chittenango road bridge, third step, east wing, tow-path abutment	11.932	433.332
61	Chittenango aqueduct, stone under coping of parapet, west wing, tow-path side near joint	11.296	432.696
62	Bolivar road bridge, stone under coping of buttress, west wing, tow-path abutment	12.541	433.941
63	White's road bridge, coping buttress, east wing, tow-path abutment	13.783	435.183

64	Pool's brook waste-weir, southeast corner, east end coping of parapet (not marked)..	10.451	431.851
65	Pool's brook road bridge, coping buttress, east wing, tow-path abutment......... .	13.470	434.870
66	Kirkville road bridge, coping buttress, west wing, tow-path abutment	14.005	435.405
67	Culvert No. 48 (one-half mile west of Kirkville), northeast corner coping tow-path parapet..	4.681	426.081
68	Manlius Center road bridge, coping, east buttress, tow-path abutment............	13.039	434.439
69	S. and C. V. R. R. bridge, second step, west wing, tow-path abutment............	10.500	431.900
70	Limestone aqueduct, southwest corner parapet coping, west wing, tow-path side ...	12.710	434.110
71	Burdick's culvert, No. 50, west stone, west wing, tow-path side	1.988	423.388
72	Butternut aqueduct, end stone, east wing, tow-path side.......................	12.491	433.891
73	Thompson's landing road bridge, coping, west buttress, tow-path abutment.........	12.167	433.567
74	West powder house, southeast corner, stone door sill (not marked)...............	8.759	430.159
75	Stop-gate (one-half mile east of lock No. 47), west end of coping, tow-path side....	8.604	430.004
76	Lock No. 47, southeast, hollow quoin, tow-path lock, lift of lock No. 47, 10.175 feet, eastward	9,184	430.584
	SHORT LEVEL — ELEVATION OF C. B. 411.225+T. W.		
77	Lock No. 48, southeast, hollow quoin, tow-path lock, lift of lock No. 48, 10.538 feet, eastward..	8.736	419.961
	MILE LEVEL — ELEVATION OF C. B. 400.687+T. W.		
78	William street bridge, Syracuse, third step, east wing, tow-path abutment.........	12.014	412.701
79	Lock No. 49, southeast, hollow quoin, tow-path lock, lift of lock No. 49, 6.991 feet, eastward	8.913	409.600
	SYRACUSE LEVEL—ELEVATION OF C. B. 393.696+T. W.		
80	Weigh-lock, Syracuse, northeast, hollow quoin.............................. ...	9.027	402.723
81	West street, Syracuse southeast corner of foundation under east tow-path column ..	11.700	405.396
82	Geddes street, Syracuse, fourth step, east wing, tow-path abutment..............	11.649	405.345
83	West Genesee street, Syracuse, coping buttress, west wing, tow-path abutment.....	13.129	406.826
84	Bridge street, Syracuse, coping buttress, west wing, tow-path abutment..........	13.591	407.287

TABLE No. 5 — MIDDLE DIVISION — *List of benches, etc.*— (Continued).

Number.	DESCRIPTION.	Elevation above C. B.	Elevation above T. W.
	ERIE CANAL — SYRACUSE LEVEL — (Continued).		
85	Discharge well, near Salt company's bridge, southwest corner, stone coping	10.047	403.743
86	Gere's Landing road bridge, coping buttress, west wing, tow-path abutment	13.481	407.177
87	Lock No. 50, southeast, hollow quoin, towpath lock, between anchors, lift of lock No. 50, 7,872 feet, westward	16.761	410.458
	JORDAN LEVEL — ELEVATION OF C. B. 401,568+T. W.		
88	Culvert No. 57 (one-half mile west of lock No. 50), coping parapet, east end, tow-path side	3.110	404.678
89	Belle Isle road-bridge, coping buttress, east wing, tow-path abutment	13.564	415.132
90	Amboy road bridge, coping buttress, east wing, tow-path abutment	13.802	415.370
91	Camillus aqueduct, northeast corner, east wing, coping parapet, tow-path side	12.475	414.043
92	Camillus road and change-bridge, coping buttress, east wing, tow-path abutment	12.708	414.276
93	Newport road bridge, coping buttress, east wing, tow-path abutment	12.358	413.926
94	Memphis road bridge, coping buttress, east wing, tow-path abutment	14.231	415.799
95	Culvert No. 60 (three-fourths of a mile west of Memphis) northeast corner coping of buttress, west tow-path wing	4.486	406.054
96	Peru road bridge, coping buttress, west wing, tow-path abutment	12.342	413.910
97	Shanty Point farm bridge, coping buttress, east wing, towpath abutment	12.576	414.144
98	Culvert No. 62 (three-eighths of a mile east of Jordan) coping tow-path parapet near center	4.874	406.442
99	Beaver street bridge, Jordan, coping buttress, east wing, tow-path abutment	13.206	414.774
100	Jordan aqueduct, coping parapet, east wing, tow-path side	12.558	414.126
101	Lock No. 51, southeast hollow quoin, tow-path lock, between anchors, lift of lock No. 51, 5.580 feet eastward	8.943	410.511

	PORT BYRON LEVEL, ELEVATION OF C. B. 395.988+T. W.		
102	Cold Spring road bridge, third step, west wing, tow-path abutment	10.664	406.652
103	Fountainville road bridge, fourth step, east wing, tow-path abutment	12.012	408.000
104	Field's road bridge, second step, east wing, tow-path abutment	10.036	406.024
105	Putnam's farm bridge, third step, east wing, tow-path abutment	11.678	407.666
106	Young's farm bridge, second step, east wing, tow-path abutment	11.075	407.063
107	Weedsport waste-weir, east end, east wall of bulkhead	8.768	404.756
108	Seneca street bridge, Weedsport, third step, east wing, tow-path abutment	10.918	406.906
109	Brutus street bridge, Weedsport, third step, east wing, tow-path abutment	11.935	407.923
110	Centerport aqueduct, coping east buttress, west wing, tow-path side	8.605	404.593
111	Centerport road bridge, fifth step, east wing, tow-path abutment	13.243	409.231
112	Utica street bridge, Port Byron, fifth step, east wing, tow-path abutment	12.461	408.449
113	Port Byron aqueduct, coping north buttress, east wing, tow-path side	8.539	404.527
114	Lock No. 52, southeast hollow quoin, tow-path lock, lift of lock No. 52, 11.417 feet, eastward	8.442	404.430
	MONTEZUMA LEVEL, ELEVATION OF C. B. 384.571+T. W.		
115	Houghtaling road bridge, third step, east wing, tow-path abutment	10.939	395.510
116	Crane Brook aqueduct, coping parapet, end of west wing, tow-path side	12.570	397.141
117	Salt street bridge, Montezuma, fourth step, west wing, tow-path abutment	12.636	397.207
118	Clark street bridge, Montezuma, third step, west wing, tow-path abutment	12.095	396.666
119	Seneca river aqueduct, northeast corner, coping parapet, east wing, north buttress	12.393	396.964
120	Seneca river aqueduct, coping parapet, west wing, north buttress	12.254	396.825
121	May's Point road and change-bridge, third step, west wing, south abutment	12.164	396.735
122	Culvert No. 80 (one and one-fourth mile west of May's Point), southwest corner coping of tow-path parapet	5.334	390.905
W. Div.	Road bridge, Wayne county line, coping buttress, east wing, tow-path abutment	12.407	396.978

TABLE No. 5 — MIDDLE DIVISION — OSWEGO CANAL — *List of benches, etc.* — (Continued).

Number.	DESCRIPTION.	Elevation above C. B.	Elevation above T. W.
	SYRACUSE LEVEL No. 1—ELEVATION OF C. B. 393.696 +T. W.		
1	Willow street bridge, Syracuse, third step, south wing, tow-path abutment	12.967	406.663
2	Division street bridge, Syracuse, third step, south wing, tow-path abutment	11.165	404.861
3	Bear street bridge, Syracuse, first step, south wing, tow-path abutment	10.271	403.967
4	Lock No. 1, northeast (lower berme) recess quoin	9.093	402.789
	(Lift of lock No. 1, 10.907 southward.)		
	LEVEL No. 2—ELEVATION OF C. B. 382.789 +T. W.		
5	Lock No. 2, southwest (upper tow-path) recess quoin	8.998	391.787
	(Lift of lock No. 2, 11.002 southward.)		
	LEVEL No. 3—ELEVATION OF C. B. 371.787 +T. W.		
6	Lock No. 3 northwest (lower tow-path) recess quoin	8.803	380.590
	(Lift of lock No. 3, 10.614 southward.)		
	LIVERPOOL LEVEL No. 4—ELEVATION OF C. B. 361.173 +T. W.		
6	Lock No. 3, northwest (lower tow-path), recess quoin	19.417	380.590
7	Change bridge (No. 8), coping of buttress, north wing, west abutment	11.928	373.101
8	Greenpoint road and change bridge (No. 9), coping of north wing, east abutment	11.789	372.962
9	R., W. & O. R. R. bridge, coping of buttress, south wing, tow-path abutment	10.477	371,650
10	Bloody brook culvert (C. 2), coping of southwest wing	3.767	364.940
11	Liverpool road bridge (No. 10), first step, south wing, tow-path abutment	10.904	372.077
12	Sawmill culvert (C. 3) coping southwest wing	3.758	364.931
13	Road and change bridge (No. 11) near lock 5, first step, south wing, west abutment.	11.977	373.150
14	Lock No. 5, northeast (lower tow-path) hollow-quoin (between anchors)	9.544	370.717
	(Lift of lock No. 5 (at low water), 9.859 southward.)		

	LEVEL NO. 5 (RIVER) — ELEVATION OF C. B., 351.314+T. W.		
14	Lock No. 5, northeast (lower tow-path) hollow-quoin (between anchors)	19.403	370.717
15	Cold Spring bridge (No. 12) second step, east wing, tow-path abutment	19.593	370.907
15½	Near Belgium bridge (No. 13) on north end of door-sill of house, 51 feet north of north side of bridge, not marked..	17.939	369.253
16	Guard-lock No. 1, southeast (upper tow-path) hollow-quoin (between anchors)	12.922	364.236
	LEVEL NO. 6 — ELEVATION OF C. B. 351.469+T. W.		
16	Guard-lock No. 1, southeast (upper tow-path) hollow-quoin (between anchors).....	12.767	364.236
17	Road and change bridge (No. 17) third step, south wing, east abutment..........	13.245	364.714
18½	Hinmanville change bridge (No. 18) second step, north wing west abutment (not marked)..	12.726	364.195
18	Lock No. 6, northeast (lower tow-path) hollow-quoin (between anchors).......... (Lift of lock No. 6, 7.355 southward.)	8.999	360.468
	LEVEL NO. 7 — ELEVATION OF C. B. 344.114+T. W.		
18	Lock No. 6, northeast (lower tow-path) hollow-quoin (between anchors)	16.354	360.468
19	Guard-lock No. 2, northeast (lower tow-path) hollow-quoin (between anchors).....	15.601	359.715
20	Lock No. 7, middle tow path, hollow-quoin (between anchors).................. (Lift of lock No. 7 (at low water), 5.679 southward.)	9.236	353.350
	LEVEL NO. 8 (RIVER) — ELEVATION OF C. B. 338.435+T. W.		
20	Lock No 7, middle tow-path, hollow-quoin (between anchors)....................	14.915	353.350
21	Guard lock No. 3, northeast (lower tow-path) hollow quoin (betweenanchors)	13.469	351.904
	LEVEL NO. 9 — ELEVATION OF C. B. 338.539+T. W.		
21	Guard lock No. 3, northeast (lower tow-path) hollow-quoin (between anchors).....	13.365	351.904
22	Pratt street bridge, Fulton (No. 20), second step, south wing, tow-path abutment ..	12.337	350.876
23	Lock No. 8, northeast (lower tow-path) hollow-quoin (between anchors)........... (Lift of lock No. 8, 11.188 southward.)	9.271	347.810

TABLE 5 — MIDDLE DIVISION — OSWEGO CANAL — *List of benches, etc.*— (Continued).

Number.	DESCRIPTION.	Elevated above C. B.	Elevated above T. W.
	LEVEL No. 10 — ELEVATION OF C. B. 327.351+T. W.		
23	Lock No. 8, northeast (lower tow-path) hollow-quoin (between anchors)	20.459	347.810
24	Lock No. 9, middle tow-path, hollow-quoin (between anchors)	9.910	337.061
	(Lift of lock No. 9, 7.303 southward.)		
	LEVEL No. 11 — ELEVATION OF C. B. 320.048+T. W.		
24	Lock No. 9, middle tow-path, hollow-quoin (between anchors)	17.013	337.061
25	Lock No. 10, northeast (lower tow-path) hollow-quoin (between anchors)	8.829	328.877
	(Lift of lock No. 10, 9.041 southward.)		
	LEVEL No. 12 — ELEVATION OF C. B. 311.007+T. W.		
25	Lock No. 10, northeast (lower tow-path) hollow-quoin (between anchors)	17.870	328.877
26	Harrison street bridge, Fulton, first step, south wing, tow-path abutment	12.088	323.095
27	Plank road and change bridge (No. 25), first step, south wing, east abutment	11.380	322.387
28	Lock No. 11, middle tow-path, hollow quoin (between anchors)	9.074	320.081
	(Lift of lock No. 11 (at low water), 11.544 southward.)		
	LEVEL No. 13 (RIVER) — ELEVATION OF C. B. 299.463+T. W.		
28	Lock No. 11, middle tow-path, hollow-quoin (between anchors)	20.618	320.081
29	Guard lock No. 4, middle tow-path, hollow-quoin (between anchors)	12.471	311.934
	LEVEL No. 14 — ELEVATION OF C. B. 299.471+T. W.		
29	Guard lock No. 4, middle tow-path, hollow-quoin (between anchors)	12.463	311.934
30	Bundyville, change bridge (No. 28) second step, south wing, west abutment	....	....
31	Lock No. 12, middle tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 12, at low water, southward.)		

	LEVEL No. 15 (RIVER) — ELEVATION OF C. B. +T. W.		
31	Lock No. 12, middle tow-path, hollow-quoin (between anchors)	....	....
32	Lock No. 13, northeast (lower tow-path) hollow-quoin (between anchors)	....	....
	(Lift of lock No. 13, southward.)		
	LEVEL No. 16 — ELEVATION OF C. B. +T. W.		
32	Lock No. 13, northeast (lower tow-path) hollow-quoin (between anchors)	....	....
33	Lock No. 14, northeast (lower tow-path) hollow-quoin (between anchors)	....	....
	(Lift of Lock No. 14, southward.)		
	LEVEL No. 17 — ELEVATION OF C. B. +T. W.		
33	Lock No. 14, northeast (lower tow-path) hollow-quoin (between anchors)	....	....
34	Lock No. 15, northeast (lower tow-path) hollow-quoin (between anchors)	....	....
	(Lift of lock No. 15, southward.)		
	LEVEL No. 18 — ELEVATION OF C. B. +T. W.		
34	Lock No. 15, northeast (lower tow-path) hollow-quoin (between anchors)	....	....
35	Lock No. 16, northeast (lower tow-path) hollow-quoin (between anchors)	....	....
	(Lift of lock No. 16, at low water, southward.)		
	LEVEL No. 19 (RIVER) — ELEVATION OF C. B. +T. W.		
35	Lock No. 16, northeast (lower tow-path) hollow-quoin (between anchors)	....	....
36	Guard, lock No. 5, northeast (lower tow-path) hollow-quoin (between anchors)	....	....
	LEVEL No. 20 — ELEVATION OF C. B. +T. W.		
36	Guard-lock No. 5, northeast (lower tow-path) hollow-quoin (between anchors)	....	....
37	Lock No. 17, northeast (lower tow-path) hollow-quoin (between anchors)	....	....
	(Lift of lock No. 17, southward.)		
	LEVEL No. 21 — ELEVATION of C. B. +T. W.		
37	Lock No. 17, northeast (lower tow-path) hollow-quoin (between anchors)	....	....
38	Lock No. 18, northeast (lower tow-path) hollow-quoin (between anchors)	....	....
	(Lift of lock No. 18 (at low water), southward.)		

TABLE 5 — MIDDLE DIVISION — OSWEGO CANAL — *List of benches, etc.*— (Concluded).

Number.	DESCRIPTION.	Elevated above C. B.	Elevated above T. W.
	OSWEGO HARBOR — ELEVATION OF C. B. +T. W.		
38	Lock No. 18, northeast (lower tow-path) hollow-quoin (between anchors).........	....	....
39	Lock No. 18, lower miter-sill at northeast gate (not marked).....................	0.000	....

TABLE 5 — MIDDLE DIVISION — *List of benches, etc.* — (Continued).

Number.	DESCRIPTION.	Elevation above C. B.	Elevation above T. W.
	CAYUGA AND SENECA CANAL — MONTEZUMA LEVEL No. 11 — ELEVATION OF C. B. 384.571+T. W.		
1	Lock No. 11, southeast (lower berme) hollow-quoin (between anchors)............	8.921	393.492
	(Lift of lock No. 11, 3.194 eastward.)		
	CAYUGA LEVEL No. 10 — ELEVATION OF C. B. 381.377+T. W.		
1	Lock No. 11, southeast (lower berme) hollow-quoin (between anchors)	12.115	393.492
2	Ransom's road bridge, fourth step, south wing, tow-path abutment...............	12.045	393.422
3	Stahlnecker's farm bridge, bottom step, south wing, tow-path abutment...........	10.369	391.746
4	Free bridge, third step, south wing, tow-path abutment (on hole in stone, bolt gone)..	11.769	393.146
5	Lock No. 9, northwest (lower tow-path) hollow-quoin (between anchors)	9.113	390.490
	(Lift of lock No. 9, 9.799 eastward.)		
	RIVER LEVEL No. 9 (*crossing Cayuga Lake outlet*) — ELEVATION OF C. B. 371.578+T. W.		
5	Lock No. 9, northwest (lower tow-path) hollow-quoin (between anchors)	18.912	390.490
6	Lock No. 8, northwest (upper tow-path) hollow-quoin (between anchors)	14.451	386.029
	(Lift of lock No. 8, 6.481 westward.)		
	LEVEL No. 8 — ELEVATION OF C. B. 378.059+T. W.		
6	Lock No. 8, northwest (upper tow-path) hollow-quoin (between anchors)	7.970	386.029
7	Demont's road bridge, third step, west wing, tow-path abutment	12.116	390.175
8	Lock No. 7, northwest (upper tow-path) hollow-quoin (between anchors)	14.810	392.869
	(Lift of lock No. 7, 5.477 westward.)		

TABLE 5 — MIDDLE DIVISION — *List of benches, etc.* — (Continued).

Number.	DESCRIPTION.	Elevation above C. B.	Elevation above T. W.
	CAYUGA AND SENECA CANAL — LEVEL No. 7 — ELEVATION OF C. B. 383.536+T. W.		
8	Lock No. 7, northwest (upper tow-path) hollow-quoin (between anchors)	9.333	392.869
9	Lock No. 6, northwest (upper tow-path) hollow-quoin (between anchors)	18.828	402.364
	(Lift of lock No. 6, 10.189 westward.)		
	LEVEL No. 6 — ELEVATION OF C. B. 393.725+T. W.		
9	Lock No. 6, northwest (upper tow-path) hollow-quoin (between anchors)	8.639	402.364
10	Lock No. 5, southwest (upper tow-path) hollow-quoin (between anchors), one and one-half feet from heel post, not marked	17.616	411.341
	(Lift of lock No. 5, 8.430 westward.)		
	LEVEL No. 5 — ELEVATION OF C. B. 402.155+T. W.		
10	Lock No. 5, southwest (upper tow-path) hollow-quoin (between anchors) one and one-half feet from heel post, not marked	9.186	411.841
11	Lock No. 4, southwest (upper tow-path) hollow-quoin (between anchors) one and one-half feet from heel post, not marked	18.649	420.804
	(Lift of lock No. 4, 9.288 westward.)		
	LEVEL No. 4 — ELEVATION OF C. B. 411.443+T. W.		
11	Lock No. 4, southwest (upper tow-path) hollow-quoin (between anchors) one and one-half feet from heel post, not marked	9.361	420.804
12	Lock No. 3, first recess stone above northwest upper berme, hollow-quoin	20.886	432.329
	(Lift of lock No. 3, 9.763 westward.)		

	LEVEL NO. 3 — ELEVATION OF C. B. 421.206+T. W.		
12	Lock No. 3, first recess stone above northwest (upper berme) hollow-quoin........	11.123	432.329
13	Sackett's creek bridge, northeast corner, top step, north wing, west abutment, not marked	10.295	431.501
14	Kingdom road bridge, second step, east wing, tow-path abutment.................	13.096	434.302
15	Lock No. 2, southeast (lower tow-path) hollow-quoin (between anchors).	15.362	436.568
	(Lift of lock No. 2, 6.904 westward.)		
	LEVEL NO. 2 — ELEVATION OF C. B. 428.110+T. W.		
15	Lock No. 2, southeast (lower tow-path) hollow-quoin (between anchors)	8.458	436.568
16	Lock No. 1, southeast (lower tow-path) hollow-quoin (between anchors)	18.292	446.402
	(Lift of lock No. 1, 7.403 westward.)		
	LEVEL NO. 1 — ELEVATION OF C. B. 435.513+T. W.		
16	Lock No. 1, southeast (lower towpath) hollow-quoin (between anchors)............	10.889	446.402
17	Locust street bridge, Waterloo, southwest corner, lower step, west wing, north abutment, not marked	11.694	447.207
18	Geneva, Ithaca and Sayre railroad bridge, southwest corner, lower step, west wing, tow-path abutment, not marked	14.899	450.412
19	Teal's road bridge, coping east buttress, tow-path abutment	14.616	450.129
20	Pre-emption road bridge, second step, west wing, tow-path abutment	16.127	451.640
21	Evans street bridge, Geneva, east buttress, tow-path abutment	15.766	451.279
22	Lake street bridge, Geneva, second step, east wing, tow-path abutment, not marked.	15.647	451.160
	CAYUGA BRANCH LEVEL NO. 10 — ELEVATION OF C. B. 381.377+T. W.		
23	Lock No. 10, southwest (lower tow-path) hollow-quoin (between anchors)	9.403	390.780
	(Lift of lock No. 10, 9.709 northward.)		
	SENECA RIVER, BETWEEN CAYUGA LAKE AND CROSS LAKE.		
1	Lock No. 10 (Cayuga and Seneca canal) between anchors, lower tow-path, hollow-quoin, marked □ with chisel...	—0.008	390.813
2	Lock No. 9 (Cayuga and Seneca canal) between anchors, lower berme, hollow-quoin, marked □ with chisel...	—0.234	390.587

TABLE 5 — MIDDLE DIVISION — *List of benches, etc.* — (Continued).

Number.	DESCRIPTION.	Elevation above C. B.	Elevation above T. W.
	SENECA RIVER, BETWEEN CAYUGA LAKE AND CROSS LAKE — (*Concluded*).		
3	Seneca river aqueduct, coping on parapet northeast corner of projection over fifteenth pier from east end, marked □ with chisel	+6.049	396.870
3½	Center of grey limestone monument on rear slope of towpath five feet from rear angle, about 2,000 feet west of Seneca river aqueduct, at old crossing of Canandaigua river, not marked	—1.226	388.595
4	West Shore railroad bridge, southeast corner of coping, tenth pier from east end, marked □ with chisel	—4.799	386.022
5	New York Central and Hudson River railroad bridge, coping forty-ninth pier from east end, south track, marked □ with chisel	—4.687	386.134
6	Center of grey limestone monument, east side of highway, fifty-four and three-tenth feet northerly from northeast corner and in line with east side of Mosquito Point bridge, not marked	—0.336	390.485
7	Iron road bridge over Seneca river one mile west of Cross lake, west corner of stone under south end of west truss, sixty-five-one hundredth foot from side and two and one-tenth feet from end of truss casting, marked □ with chisel	—6.059	384.762

TABLE No. 5 — MIDDLE DIVISION — BLACK RIVER CANAL — *List of benches, etc.* — (Continued).

Number.	DESCRIPTION.	Elevation above C. B.	Elevation above T. W.
	ERIE LEVEL No. 1 — ELEVATION OF C. B. +T. W.		
1	Lock No. 1, upper berme, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 1, northward.)		
	(Lower mitre-sill of lock No. 1.)		
	LEVEL No. 2 — ELEVATION OF C. B. +T. W.		
1	Lock No. 1, upper berme, hollow-quoin (between anchors)	....	....
2	Lock No. 2, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 2, northward.)		
	LEVEL No. 3 — ELEVATION OF C. B. +T. W.		
2	Lock No. 2, upper tow-path, hollow-quoin (between anchors)	....	....
3	Lock No. 3, upper berme, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 3, northward.)		
	LEVEL No. 4 — ELEVATION OF C. B. +T. W.		
3	Lock No. 3, upper berme, hollow-quoin (between anchors)	....	....
4	Lock No. 4, upper berme, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 4, northward.)		
	LEVEL No. 5 — ELEVATION OF C. B. +T. W.		
4	Lock No. 4, upper berme, hollow-quoin (between anchors)	....	....
5	Lock No. 5, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 5, northward.)		

TABLE No. 5 — Middle Division — Black River Canal — *List of benches, etc.* — (Continued).

Number.	DESCRIPTION.	Elevation above C. B.	Elevation above T. W.
	Level No. 6 — Elevation of C. B. +T. W.		
5	Lock No. 5, upper tow-path, hollow-quoin (between anchors)	....	....
6	Lock No. 6, upper berme, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 6, northward.)		
	Level No. 7 — Elevation of C. B. +T. W.		
6	Lock No. 6, upper berme, hollow-quoin (between anchors)	....	....
7	Lock No. 7, upper berme, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 7, northward.)		
	Level No. 8 — Elevation of C. B. +T. W.		
7	Lock No. 7, upper berme, hollow-quoin (between anchors)	....	....
8	Lock No. 8, upper berme, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 8, northward.)		
	Level No. 9 — Elevation of C. B. +T. W.		
8	Lock No. 8, upper berme, hollow-quoin (between anchors)	....	....
9	Lock No. 9	....	....
	(Lift of lock No. 9, northward.)		
	Level No. 10 — Elevation of C. B. +T. W.		
9	Lock No. 9	....	....
10	Lock No. 10	....	....
	(Lift of lock No. 10, northward.)		

	LEVEL No. 11, ELEVATION OF C. B. +T. W.		
10	Lock No. 10	....	....
11	Lock No. 11	....	....
	(Lift of lock No. 11, northward.)		
	LEVEL No. 12, ELEVATION OF C. B. +T. W.		
11	Lock No. 11	....	....
12	Lock No. 12, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 12, northward.)		
	LEVEL No. 13 — ELEVATION OF C. B. +T. W.		
12	Lock No. 12, upper tow-path, hollow-quoin (between anchors)	....	....
13	Lock No. 13	....	....
	(Lift of lock No. 13, northward.)		
	LEVEL No. 14 — ELEVATION OF C. B. +T. W.		
13	Lock No. 13	....	....
14	Lock No. 14	....	....
	(Lift of lock No. 14, northward.)		
	LEVEL No. 15 — ELEVATION OF C. B. +T. W.		
14	Lock No. 14	....	....
15	Lock No. 15, upper berme, hollow quoin (between anchors)	....	....
	(Lift of lock No. 15, northward.)		
	LEVEL No. 16 — ELEVATION OF C. B. +T. W.		
15	Lock No. 15, upper berme, hollow-quoin (between anchors)	....	....
16	Lock No. 16, upper tow-path, hollow quoin (between anchors)	....	....
	(Lift of lock No. 16, northward.)		

TABLE No. 5 — MIDDLE DIVISION — BLACK RIVER CANAL — *List of benches, etc.* — (Continued).

Number.	DESCRIPTION.	Elevated above C. B.	Elevated above T. W.
	LEVEL No. 17 — ELEVATION OF C. B. +T. W.		
16	Lock No. 16, upper tow-path, hollow-quoin (between anchors)	....	....
17	Lock No. 17, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 17, northward.)		
	LEVEL No. 18 — ELEVATION OF C. B. +T. W.		
17	Lock No. 17, upper tow-path, hollow-quoin (between anchors)	....	....
18	Lock No. 18, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 18, northward.)		
	LEVEL No. 19 — ELEVATION OF C. B. +T. W.		
18	Lock No. 18, upper tow-path, hollow-quoin (between anchors)	....	....
19	Lock No. 19, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 19, northward.)		
	LEVEL No. 20 — ELEVATION OF C. B. +T. W.		
19	Lock No. 19, upper tow-path, hollow-quoin (between anchors)	....	....
20	Lock No. 20, upper tow-path, hollow-quoin (between anchors),	....	....
	(Lift of lock No. 20, northward.)		
	LEVEL No. 21 — ELEVATION OF C. B. +T. W.		
20	Lock No. 20, upper tow-path, hollow-quoin (between anchors)	....	....
21	Lock No. 21, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 21, northward.)		

	LEVEL No. 22 — ELEVATION OF C. B. +T. W.		
21	Lock No. 21, upper tow-path, hollow-quoin (between anchors)	....	....
22	Lock No. 22, lower tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 22, northward.)		
	LEVEL No. 23 — ELEVATION OF C. B. +T. W.		
22	Lock No. 22, lower tow-path, hollow-quoin (between anchors)	....	....
23	Lock No. 23, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 23, northward.)		
	LEVEL No. 24 — ELEVATION OF C. B. +T. W.		
23	Lock No. 23, upper tow-path, hollow-quoin (between anchors)	....	....
24	Lock No. 24, first coping-stone south of upper tow-path, hollow-quoin	....	....
	(Lift of lock No. 24, northward.)		
	LEVEL No. 25 — ELEVATION OF C. B. +T. W.		
24	Lock No. 24, first coping-stone south of upper tow-path, hollow-quoin	....	....
25	Lock No. 25, in coping $15\frac{85}{100}$ feet south of upper ——— hollow-quoin	....	..,......
	(Lift of lock No. 25, northward.)		
	LEVEL No. 26 — ELEVATION OF C. B. +T. W.		
25	Lock No. 25, in coping $15\frac{85}{100}$ feet south of upper........ hollow quoin	....	....
26	Lock No. 26, upper berme hollow-quoin (between anchors)	....	....
	(Lift of lock No. 26, northward.)		
	LEVEL No. 27 — ELEVATION OF C. B. +T. W.		
26	Lock No. 26, upper berme, hollow-quoin (between anchors)	....	....
27	Lock No. 27, lower tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 27, northward.)		

TABLE 5 — MIDDLE DIVISION — BLACK RIVER CANAL — *List of benches, etc*— (Continued).

Number.	DESCRIPTION	Elevation above C. B.	Elevation above T. W.
	LEVEL No. 28 — ELEVATION OF C. B. +T. W.		
27	Lock No. 27, lower tow-path, hollow-quoin (between anchors)	....	....
28	Lock No. 28, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 28, northward.)		
	LEVEL No. 29 — ELEVATION OF C. B. +T. W.		
28	Lock No. 28, upper tow-path, hollow-quoin (between anchors)	....	....
29	Lock No. 29, lower tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 29, northward.)		
	LEVEL No. 30 — ELEVATION OF C. B. +T. W.		
29	Lock No. 29, upper tow-path, hollow-quoin (between anchors)	....	....
30	Lock No. 30, lower berme, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 30, northward.)		
	LEVEL No. 31 — ELEVATION OF C. B. +T. W.		
30	Lock No. 30, lower berme, hollow-quoin (between anchors)	....	....
31	Lock No. 31, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 31, northward.)		
	LEVEL No. 32 — ELEVATION OF C. B. +T. W.		
31	Lock No. 31, upper tow-path, hollow-quoin (between anchors)	....	....
32	Lock No. 32, first recess coping above upper tow-path, hollow-quoin	....	....
	(Lift of lock No. 32, northward.)		

	LEVEL No. 33 — ELEVATION OF C. B. +T. W.		
32	Lock No. 32, first recess coping above upper tow-path, hollow-quoin	....	....
33	Lock No. 33, upper berme, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 33, northward.)		
	LEVEL No. 34 — ELEVATION OF C. B. +T. W.		
33	Lock No. 33, upper berme, hollow-quoin (between anchors)	....	....
34	Lock No. 34, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 34, northward.)		
	LEVEL No. 35 — ELEVATION OF C. B. +T. W.		
34	Lock No. 34, upper tow-path, hollow-quoin (between anchors)	....	....
35	Lock No. 35, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 35, northward.)		
	LEVEL No. 36 — ELEVATION OF C. B. +T. W.		
35	Lock No. 35, upper tow-path, hollow-quoin (between anchors)	....	....
36	Lock No. 36, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 36, northward.)		
	LEVEL No. 37 — ELEVATION OF C. B. +T. W.		
36	Lock No. 36, upper tow-path, hollow-quoin (between anchors)	....	....
37	Lock No. 37, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 37, northward.)		
	LEVEL No. 38 — ELEVATION OF C. B. +T. W.		
37	Lock No. 37, upper tow-path, hollow-quoin (between anchors)	....	....
38	Lock No. 38, lower tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 38, northward.)		

TABLE 5 — MIDDLE DIVISION — BLACK RIVER CANAL — *List of benches, etc.* — (Continued).

Number.	DESCRIPTION.	Elevation above C. B.	Elevation above T. W.
	LEVEL NO. 39 — ELEVATION OF C. B. +T. W.		
38	Lock No. 38, lower tow-path, hollow-quoin (between anchors)	....	....
39	Lock No. 39, lower end of first stone below lower tow-path, hollow quoin (rear corner).	....	....
	(Lift of lock No. 39, northward.)		
	(Lift of lock No. 40, northward.)		
	(Lift of lock No. 41, northward.)		
	(Lift of lock No. 42, northward.)		
	(Lift of lock No. 43, northward.)		
	LEVEL NO. 40 — ELEVATION OF C. B. +T. W.		
40	Lock No. 43, opposite heel post, upper tow-path gate..........................	....	....
41	Lock No. 44, end coping stone, lower tow-path wing.........................	....	....
	(Lift of lock No. 44, northward.)		
	(Lift of lock No. 45, northward.)		
	(Lift of lock No. 46, northward.)		
	LEVEL NO. 41 — ELEVATION OF C. B. +T. W.		
42	Lock No. 46, upper tow-path, hollow-quoin (between anchors)	....	....
43	Lock No. 47	....	....
	(Lift of lock No. 47, northward.)		
	LEVEL NO. 42 — ELEVATION OF C. B. +T. W.		
43	Lock No. 47	....	....
44	Lock No. 48, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 48, northward.)		

	LEVEL No. 43 — ELEVATION OF C. B. + T. W.		
44	Lock No. 48, upper tow-path, hollow-quoin (between anchors)	....	....
45	Lock No. 49, upper tow-path, hollow quoin (between anchors)	....	....
	(Lift of lock No. 49, northward.)		
	LEVEL No. 44 — ELEVATION OF C. B. + T. W.		
45	Lock No. 49, upper tow-path hollow-quoin (between anchors)	....	....
46	Lock No. 50	....	....
	(Lift lock No. 50, northward.)		
	LEVEL No. 45 — ELEVATION OF C. B. + T. W.		
46	Lock No. 50	....	....
47	Lock No. 51, first recess stone above lower berme, hollow-quoin	....	....
	(Lift of lock No. 51, northward.)		
	LEVEL No. 46 — ELEVATION OF C. B. + T. W.		
47	Lock No. 51, first recess stone above lower berme, hollow-quoin	....	....
48	Lock No. 52, first step below coping, lower tow-path wing	....	....
	(Lift of lock No. 52, northward.)		
	LEVEL No. 47 — ELEVATION OF C. B. + T. W.		
48	Lock No. 52, first step below coping, lower tow-path wing	....	....
49	Lock No. 53, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 53, northward.)		
	LEVEL No. 48 — ELEVATION OF C. B. + T. W.		
49	Lock No. 53, upper tow-path, hollow-quoin (between anchors)	....	....
50	Lock No. 54, first coping stone below upper tow-path, hollow-quoin	....	....
	(Lift of lock No. 54, northward.)		

TABLE 5 — MIDDLE DIVISION — BLACK RIVER CANAL — *List of benches, etc.*— (Continued).

Number.	DESCRIPTION.	Elevation above C. B.	Elevation above T. W.
	LEVEL No. 49 — ELEVATION OF C. B. +T. W.		
50	Lock No. 54, first coping stone below upper tow-path, hollow-qouin	....	....
51	Lock No. 55, in hollow-qouin stone opposite lower tow-path, heel-post	....	....
	(Lift of lock No. 55, northward.)		
	LEVEL No. 50 — ELEVATION OF C. B. +T. W.		
51	Lock No. 55, in hollow-quoin stone, opposite lower tow-path heel-post	....	....
52	Lock No. 56, lower berme, hollow-quoin stone, below heel-post	....	....
	(Lift of lock No. 56, northward.)		
	LEVEL No. 51 — ELEVATION OF C. B. +T. W.		
52	Lock No. 56, lower berme, hollow-quoin stone, below heel-post	....	....
53	Lock No. 57, berme lower, hollow-quoin, opposite heel-post	....	....
	(Lift of lock No 57, northward.)		
	LEVEL No. 52 — ELEVATION OF C. B. +T. W.		
53	Lock No. 57, berme lower, hollow-quoin, opposite heel-post	....	....
54	Lock No. 58, lower tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 58, northward.)		
	(Lift of lock No. 59, northward.)		
	(Lift of lock No. 60, northward.)		
	LEVEL No. 53 — ELEVATION OF C. B. +T. W.		
55	Lock No. 60, upper tow-path, hollow-quoin (between anchors)	....	....
56	Lock No. 61, lower berme, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 61, northward.)		

	LEVEL No. 54 — ELEVATION OF C. B. +T. W.		
56	Lock No. 61, lower berme, hollow-quoin (between anchors)	....	....
57	Lock No. 62, lower berme, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 62, northward.)		
	LEVEL No. 55 — ELEVATION OF C. B. +T. W.		
57	Lock No. 62, lower berme, hollow-quoin (between anchors)	....	....
58	Lock No. 63, lower berme, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 63, northward.)		
	LEVEL No. 56 — ELEVATION OF C. B. +T. W.		
58	Lock No. 63, lower berme, hollow-quoin (between anchors)	....	....
59	Lock No. 64, lower tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 64, northward.)		
	LEVEL No. 57 — ELEVATION OF C. B. +T. W.		
59	Lock No. 64, lower tow-path, hollow-quoin (between anchors)	....	....
60	Lock No. 65, first recess stone above lower berme, hollow-quoin at rear, near joint	....	....
	(Lift of lock No. 65, northward.)		
	LEVEL No. 58 — ELEVATION OF C. B. +T. W.		
60	Lock No. 65, first recess stone above lower berme, hollow-quoin at rear, near joint	....	....
61	Lock No. 66, lower tow-path, hollow-quoin, opposite heel-post	....	....
	(Lift of lock No. 66, northward.)		
	LEVEL No. 59 — ELEVATION OF C. B. +T. W.		
61	Lock No. 66, lower tow-path, hollow-quoin, opposite heel-post	....	....
62	Lock No. 67, lower tow-path, hollow-quoin, opposite heel-post	....	....
	(Lift of lock No. 67, northward.)		

TABLE 5 — MIDDLE DIVISION — BLACK RIVER CANAL — *List of benches, etc.*— (Continued).

Number.	DESCRIPTION.	Elevation above C. B.	Elevation above T. W.
	LEVEL No. 60 — ELEVATION OF C. B. +T. W.		
62	Lock No. 67, lower tow-path, hollow-quoin, opposite heel-post	....	....
63	Lock No. 68, first recess stone above berme, lower hollow-quoin, near joint	....	....
	(Lift of lock No. 68, northward.)		
	LEVEL No. 61 — ELEVATION OF C. B. +T. W.		
63	Lock No. 68, first recess stone above berme, lower hollow-quoin, near joint	....	....
64	Lock No. 69, first recess stone above towpath, lower hollow-quoin, near joint	....	....
	(Lift of lock No. 69, northward.)		
	LEVEL No. 62 — ELEVATION OF C. B. +T. W.		
64	Lock No. 69, first recess stone above towpath, lower hollow-quoin, near joint	....	....
65	Lock No. 70, middle recess stone berme, lower gate (between clamps)	....	....
	(Lift of lock No. 70, northward.)		
	LEVEL No. 63 (SUMMIT) — ELEVATION OF C. B. +T. W.		
65	Lock No. 70, middle recess stone berme, lower gate (between clamps)	....	....
66	Lock No. 71, lower tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 71, southward.)		
	LEVEL No. 64 — ELEVATION OF C. B. +T. W.		
66	Lock No. 71, lower tow-path, hollow-quoin (between anchors)	....	....
67	Lock No. 72, lower tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 72, southward.)		

	LEVEL No. 65 — ELEVATION OF C. B. +T. W.		
67	Lock No. 72, lower tow-path, hollow-quoin (between anchors)....................	....	....
68	Lock No. 73, lower tow-path, hollow-quoin (between anchors)....................	....	....
	(Lift of lock No. 73, southward.)		
	LEVEL No. 66 — ELEVATION OF C. B. +T. W.		
68	Lock No. 73, lower tow-path, hollow-quoin (between anchors)....................	....	....
69	Lock No. 74, lower tow-path, hollow-quoin (between anchors)....................	....	....
	(Lift of lock No. 74, southward.)		
	LEVEL No. 67 — ELEVATION OF C. B. ..T. W.		
69	Lock No. 74, lower tow-path, hollow-quoin (between anchors)....................	....	....
70	Lock No. 75, upper tow-path, hollow-quoin (between anchors)....................	....	....
	(Lift of lock No. 75, southward.)		
	LEVEL No. 68 — ELEVATION OF C. B. ..T. W.		
70	Lock No. 75, upper tow-path, hollow-quoin (between anchors)....................	....	....
71	Lock No. 76, lower tow-path, hollow-quoin (between anchors)....................	....	....
	(Lift of lock No. 76, southward.)		
	(Lift of lock No. 77, southward.)		
	(Lift of lock No. 78, southward)		
	(Lift of lock No. 79, southward.)		
	LEVEL No. 69 — ELEVATION OF C. B. ..T. W.		
72	Lock No. 79, lower tow-path, hollow-quoin (between anchors)....................	....	....
73	Lock No. 80, lower tow-path, hollow-quoin (between anchors)....................	....	....
	(Lift of lock No. 80, southward.)		

TABLE 5 — MIDDLE DIVISION — BLACK RIVER CANAL — *List of benches, etc.* — (Continued).

Number.	DESCRIPTION.	Elevation above C. B.	Elevation above T. W.
	LEVEL NO. 70 — ELEVATION OF C. B. +T. W.		
73	Lock No. 80, lower tow-path, hollow-quoin (between anchors)	....	....
74	Lock No. 81, lower berme, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 81, southward.)		
	(Lift of lock No. 82, southward.)		
	(Lift of lock No. 83, southward.)		
	(Lift of lock No. 84, southward.)		
	LEVEL NO. 71 — ELEVATION OF C. B. +T. W.		
75	Lock No. 84, lower tow-path, hollow-quoin (between anchors)	....	....
76	Lock No. 85, lower tow-path, hollow quoin (between anchors)	....	....
	(Lift of lock No. 85, southward.)		
	LEVEL NO. 72 — ELEVATION OF C. B. +T. W.		
76	Lock No. 85, lower tow-path, hollow-quoin (between anchors)	....	....
77	Lock No. 86, lower tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 86, southward.)		
	LEVEL NO. 73 — ELEVATION OF C. B. +T. W.		
77	Lock No. 86, lower tow-path, hollow-quoin (between anchors)	....	....
78	Lock No. 87, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 87, southward.)		
	(Lift of lock No. 88, southward.)		
	(Lift of lock No. 89, southward.)		
	(Lift of lock No. 90, southward.)		

	LEVEL No. 74 — ELEVATION OF C. B. +T. W.		
79	Lock No. 90, lower tow-path, hollow-quoin (between anchors)	....	....
80	Lock No. 91, upper tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 91, southward.)		
	LEVEL No. 75 — ELEVATION OF C. B. +T. W.		
80	Lock No. 91, upper tow-path, hollow-quoin (between anchors)	....	....
81	Lock No. 92, lower tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 92, southward.)		
	LEVEL No. 76 — ELEVATION OF C. B. +T. W.		
81	Lock No. 92, lower tow-path, hollow-quoin (between anchors)	....	....
82	Lock No. 93, lower tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 93, southward.)		
	LEVEL No. 77 — ELEVATION OF C. B. +T. W.		
82	Lock No. 93, lower tow-path, hollow-quoin (between anchors)	....	....
83	Lock No. 94, lower tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 94, southward.)		
	LEVEL No. 78 — ELEVATION OF C. B. +T. W.		
83	Lock No. 94, lower tow-path, hollow-quoin (between anchors)	....	....
84	Lock No. 95, lower tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 95, southward.)		
	LEVEL No. 79 — ELEVATION OF C. B. +T. W.		
84	Lock No. 95, lower tow-path, hollow-quoin (between anchors)	....	....
85	Lock No. 96, lower tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 96, southward.)		

TABLE No. 5 — MIDDLE DIVISION — BLACK RIVER CANAL — *List of benches, etc.*— (Continued).

Number.	DESCRIPTION.	Elevation above C. B.	Elevation above T. W.
	LEVEL No. 80 — ELEVATION OF C. B. +T. W.		
85	Lock No. 96, lower tow-path, hollow-quoin (between anchors)	....	....
86	Lock No. 97, lower tow-path hollow-quoin (between anchors)	....	....
	(Lift of lock No. 97, southward.)		
	LEVEL No. 81 — ELEVATION OF C. B. +T. W.		
86	Lock No. 97, lower tow-path, hollow-quoin (between anchors)	....	....
87	Lock No. 98, lower tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 98, southward.)		
	LEVEL No. 82 — ELEVATION OF C. B. +T. W.		
87	Lock No. 98, lower tow-path, hollow-quoin (between anchors)	....	....
88	Lock No. 99, lower berme, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 99, southward.)		
	(Lift of lock No. 100, southward.)		
	(Lift of lock No. 101, southward.)		
	LEVEL No. 83 — ELEVATION OF C. B. +T. W.		
89	Lock No. 101, lower tow-path, hollow-quoin (between anchors)	....	....
90	Lock No. 102, lower tow-path, hollow quoin (between anchors)	....	....
	(Lift of lock No. 102 [at low water], southward.)		
	LEVEL No. 84 (RIVER) — ELEVATION OF C. B. +T. W.		
90	Lock No. 102, lower tow-path, hollow-quoin (between anchors)	....	....
91	Lock No. 103, lower tow-path, hollow-quoin (between anchors)	....	....
	(Lift of lock No. 103, southward.)		
	(Lift of lock No. 104, southward.)		
	(Lift of lock No. 105, southward.)		

	LEVEL NO. 85 — ELEVATION OF C. B. +T. W.		
92	Lock No. 105, lower tow-path, hollow-quoin (between anchors)........	....	....
93	Lock No. 106, lower tow-path, hollow-quoin (between anchors)........	....	....
	(Lift of lock No. 106, southward.)		
	(Lift of lock No. 107, southward.)		
	LEVEL NO. 86 — ELEVATION OF C. B. +T. W.		
94	Lock No. 107........	....	....
95	Lock No. 108........	....	....
	(Lift of lock No. 108, southward.)		
	(Lift of lock No. 109 [at low water], southward.)		
	LEVEL NO. 87 (RIVER) — ELEVATION OF C. B. +T. B.		
96	Lock No. 109........	....	....

MIDDLE DIVISION — NEW YORK STATE CANALS — TABLE OF BRIDGES.

There are 439 bridges on this division, namely:

On the Erie canal	**165**
On the Erie feeders	**63**
On the Oswego canal, main line	**47**
On the Oswego canal, branches	**22**
On the Cayuga and Seneca canal	**38**
On the Cayuga and Seneca canal, Ithaca inlet	**3**
On the Black River canal, main line	**67**
On the Black River improvement	**7**
On the Black River feeders	**21**
On the Black, Beaver and Moose rivers, where not used for canal purposes	**4**
On the Chemung canals	**2**
	439

Below I present in tabular form the uses and styles of these bridges, separating each canal and group of feeders.

ERIE CANAL.

STYLE.	Street or Road: Two road-ways.	Street or Road: One road-way.	Farm.	Road and change, single roadway.	Change.	Foot.	T. P.	For a special purpose.	Private: Farm.	Private: Foot.	Private: Special.	Railroad: Single.	Railroad: Double.	Totals.	Remarks.
WOODEN BRIDGES.															
Trapezoidal wooden chord	1	22	12	3	1	......	......	......	......	2	......	......	......	41	
Trapezoidal iron chord	......	11	5	......	......	1	......	......	1	......	......	......	......	18	
King post swing	......	......	......	......	......	......	1	......	......	......	......	......	......	1	
Stringer	......	......	......	......	......	......	4	......	......	......	......	......	......	4	
IRON BRIDGES.															
Whipple arch, cast	4	46	......	......	......	......	......	1	......	......	1	......	......	52	Specials carry salt mains and water pipes.
Whipple tubular arch, cast	......	1	......	......	......	......	1	......	......	......	......	......	......	2	
Cooper tubular arch, wrought	......	1	......	......	......	......	......	......	......	......	......	......	......	1	
Soule's angle arch, wrought	1	......	......	......	......	......	......	......	......	......	......	......	......	1	
Swartz suspended arch, cast	......	1	......	......	......	......	......	......	......	......	......	......	......	1	
Trapezoidal tubular, cast	......	......	......	......	1	2	2	......	......	......	......	......	......	5	
Pratt truss, riveted, wrought	......	1	......	......	......	2	......	......	......	3	1	......	......	7	Special carries steam head and power pipes.
Alden truss, riveted, wrought	......	1	......	......	......	......	......	......	......	......	......	......	......	1	
Lattice, wrought	......	......	......	......	......	......	......	......	......	......	......	3	5	8	
Pin connected, wrought	......	......	......	......	......	......	......	......	......	......	......	3	3	6	
Bollman, cast	1	1	......	......	......	......	......	......	......	......	......	......	......	2	
Simms' tubular, wrought	1	......	......	......	......	......	......	......	......	......	......	......	......	1	
Plate girder, wrought	......	......	......	......	......	1	......	......	......	......	......	......	......	1	
Suspension, wrought	......	......	......	......	......	......	......	......	......	5	......	......	......	5	
Hilton lift, wrought	......	2	......	......	......	......	......	......	......	......	......	......	......	2	
Whipple lift, wrought	......	1	......	......	......	......	......	......	......	......	......	......	......	1	
Trapezoidal riveted swing, wrought	......	1	......	......	......	......	......	......	......	......	......	2	......	3	
Plate girder swing, wrought	......	......	......	......	......	......	......	......	......	......	......	2	......	2	
Stone arch	......	1	......	......	......	......	......	......	......	......	......	......	......	1	
Totals	8	90	17	3	2	6	8	1	1	10	2	10	8	166	

ERIE CANAL FEEDERS.

	Street or road (all single).	Farm.	T. P.	R. R.	Totals.
WOODEN BRIDGES — STYLE.					
Oriskany group.					
Trapezoidal wooden chord	5	2	....	....	7
Stringer	9	20	1	....	30
Oneida feeder.					
Trapezoidal wooden chord	6	1	....	....	7
Chittenango group.					
Trapezoidal wooden chord	1	....	....	....	1
Limestone group.					
Trapezoidal wooden chord	2	3	....	....	5
Butternut feeder.					
Trapezoidal wooden chard	2	1	....	....	3
Camillus group.					
Trapezoidal wooden chord	2	....	....	....	2
Port Byron feeder.					
Trapezoidal wooden chord	1	....	....	....	1
Stringer	1	....	....	....	1
Total wood	29	27	1	....	57
IRON BRIDGES — STYLE.					
Oneida group.					
Plate girder, 4 tracks...........	....	...	....	1	1
Chittenango group.					
Whipplo arch, cast.............	2	....	....	....	2
Butternut feeder.					
Whipple arch, cast.............	1	....	....	....	1
Jordan group.					
Whipple arch, cast.............	1	....	....	....	1
Deck girder, wrought	1	....	....	....	1
Total iron.................	5	....	....	1	6
Grand total	34	27	1	1	63

OSWEGO CANAL.

STYLE.	ROAD OR STREET			ROAD AND CHANGE.								PRIVATE.				
	Two road-ways.	One road-way.	Farm.	Three road-ways.	Two road. ways.	One road-way.	Change.	Foot.	Road and T. P.	T. P.	For a special purpose.	Road.	Foot.	Railroad, single.	Railroad, double.	Totals.
WOODEN BRIDGES.			......													
Trapezoidal wooden chord	......	3	......	......	1	......	4	......	1	......	1	......	2	......	......	12
Trapezoidal iron chord	......	5	......	1	......	......	1	......	......	......	......	......	......	......	......	7
Stringer	......	......	......	......	......	......	......	......	......	1	......	......	......	......	......	1
IRON BRIDGES.			......													
Whipple arch, cast	2	11	......	......	1	......	......	......	......	......	......	......	......	......	......	14
Whipple tubular arch, cast	......	......	......	......	......	1	......	......	......	......	......	......	......	......	......	1
King arch, wrought	......	......	......	......	......	......	......	......	......	......	......	2	......	......	......	2
Trapezoidal tubular, cast	......	......	......	......	......	......	1	......	......	......	......	......	......	......	......	1
Pratt truss riveted, wrought	......	......	......	......	......	......	......	......	......	......	......	......	1	......	......	1
Deck Whipple trapezoidal, cast	......	1	......	......	......	......	......	......	......	......	......	......	......	......	1	2
Lattice, wrought	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	1
Pin connected, wrought	......	......	......	......	......	......	......	......	......	......	......	......	......	1	......	1
Plate girder, wrought	......	......	......	......	......	......	......	1	......	......	......	......	......	......	......	1
Lift, wrought	......	1	......	......	......	......	......	......	......	......	......	......	......	......	1	2
Plate girder, swing	......	......	......	......	......	......	......	......	......	......	......	......	......	1	......	1
Totals	2	21	......	1	2	1	6	1	1	1	1	2	3	2	3	47

REMARKS.— Special carries salt mains.

OSWEGO CANAL BRANCHES.

	Road, single.	T. P.	Railroad, single.	Total.
WOODEN BRIDGES — STYLE.				
Salina side cuts.				
Wooden chords	4	.....	.....	4
Stringer	2	.....	.....	2
Liverpool side cut.				
King post swing	1	.....	.....	1
Seneca river T. P.				
Float bridge	.....	1	.....	1
Baldwinsville side cut.				
King post swing	3	.....	1	4
Oneida river improvement.				
King post swing	2	.....	.....	2
Howe truss	.....	.....	1	1
Total wood	12	1	2	15
IRON BRIDGES — STYLE.				
Salina side cuts.				
Whipple arch, cast	1	.....	.....	1
Trapezoidal tubular, cast	1	.....	.....	1
Seneca river bridge at Jacks reefs.				
Whipple arch, cast	1	.....	.....	1
Baldwinsville side cut.				
Soules' arch, wrought	1	.....	.....	1
Oneida river improvement.				
Trapezoidal swing, wrought	1	.....	1	2
Onondaga outlet.				
Whipple arch, cast	1	.....	.....	1
Total iron	6	....	1	7
Grand total	18	1	3	22

CAYUGA AND SENECA CANAL AND BRANCHES.

STYLE.	ROAD OR STREET.		Farm.	ROAD OR CHANGE.		Change.	TOW PATH.		Private, special.	Railroad, single.	Totals.
	Two roadways.	One roadway.		Two roadways.	One roadway.		Bridges.	Spans.			
WOODEN BRIDGES.											
Trapezoidal wooden chord	....	4	1	....	....	1	5	20	......	......	11
Stringer	....	....	......	....	....	......	6	8	......	......	6
Stringer pile bents	....	....	......	....	....	......	2	26	......	......	2
Draw	....	....	......	....	....	......	1	1	......	......	1
Howe	....	....	......	....	....	......	....	....	......	1	1
King post swing	....	1	......	....	....	......	....	....	......	......	1
IRON BRIDGES.											
Whipple arch, cast	8	6	......	1	....	......	....	....	....	......	10
Trapezoidal tubular, cast	....	....	......	....	1	......	....	....	......	......	1
Trapezoidal deck, wrought	....	1	......	....	....	......	....	....	......	......	1
Lattice, wrought	....	....	......	....	....	......	....	....	......	1	1
Pin connected wrought	....	....	......	....	....	......	....	....	......	1	1
Malt-house carrier, wrought	....	....	......	....	....	......	....	....	1	......	1
Lift	....	....	......	....	....	......	....	....	......	1	1
ITHACA INLET.											
Trapezoidal swing, wrought	....	3	......	....	....	......	....	... .	......	......	3
Totals	8	15	1	1	1	1	14	55	1	4	41

BLACK RIVER CANAL, BLACK RIVER IMPROVEMENT, FEEDERS AND RIVERS.

STYLE.	ROAD OR STREET.		Farm.	Road and change.	Change.	Tow-path.	Private, farm.	Railroad, single.	Total.
	Two roadways.	One roadway.							
WOODEN BRIDGES.									
Trapezoidal wooden chord	......	9	27	2	1	....	....	....	39
Trapezoidal iron chord	......	3	3	....	....	....	1	....	7
Stringer	......	......	....	....	....	2	....	....	2
King post swing	......	......	....	....	....	....	....	1	1
IRON BRIDGES.									
Whipple arch, cast	1	12	....	1	....	....	....	....	14
Whipple tubular arch, cast	......	1	....	....	....	1	....	....	2
Trapezoidal, wrought	......	1	....	....	....	....	....	1	2
Totals	1	26	30	3	1	3	1	2	67

BLACK RIVER IMPROVEMENT.

BLACK RIVER IMPROVEMENT.	Number.	WOODEN SPANS.		IRON SPANS.		Wooden swings.	Iron swings, wrought.	Iron truss, railroad.	Total.
		Wooden chord.	Iron chord.	Cast.	Wrought.				
Single roadway, one sidewalk	1	......	......	......	7	....	....	....	1
Single roadway, no sidewalk	5	7	3	2	......	3	2	1	6
RIVERS NOT USED AS CANALS.									
Black river	1	......	2	......	......	....	....	....	1
Moose river	1	......	2	......	......	....	....	....	1
Junction Black and Moose river bridge	1	1	......	......	......	....	....	....	1
Beaver river	1	......	......	......	......	....	....	....	1
Totals	10	......	......	......	......	....	...	1	11

DELTA FEEDER.

DELTA FEEDER.	Road.	Farm.	River.	Bridge span.	Total.
Trapezoidal wooden chord	1	1	1	2	3
Stringer	1	1	....	....	2
LANSINGKILL.					
Stringer	....	3	....	....	3
FORESTPORT FEEDER.					
Trapezoidal wooden chord	10	2	....	....	12
Whipple arch, cast	1	....	....	....	1
Total	13	7	1	2	21

CHEMUNG CANAL.

	Road.
Plate girder, wrought	1
Whipple arch, cast	1
Total	2

APPENDIX D.

REPORT

OF THE

DIVISION ENGINEER

OF THE

WESTERN DIVISION

FOR THE

YEAR ENDING SEPTEMBER 30, 1891.

APPENDIX D.

ROCHESTER, *November* 3, 1891.

HON. JOHN BOGART, *State Engineer and Surveyor:*

Sir.—I have the honor of submitting to you my report on the western division of the State canals for the fiscal year ending September 30, 1891.

The canal slips and navigable feeders are as follows:

	Miles.
Erie canal from the east line of Wayne county to Hamburgh street in the city of Buffalo	148.92
Five slips in the city of Buffalo, aggregate length	1.60
Genesee river feeder in the city of Rochester	2.25
Total miles	152.77

Unnavigable Feeders.

	Miles.
Tonawanda and Oak Orchard creek	11.55
Genesee Valley canal from Cuba reservoir to Lock No. 87 Rockville	7.65
Genesee Valley canal from Scottsville to Rochester rapids dam	11.00
Total miles	30.20

The sources of water supply for the Erie canal are as follows:

1. Lake Erie at Buffalo.
2. Tonawanda creek at Pendleton.
3. Tonawanda and Oak Orchard creek feeder, at Medina.
4. Allen's creek, through the Genesee Valley canal and Genesee river feeder from Scottsville to Rochester.
5. The Cuba reservoir, in Allegany county, through the Genesee Valley canal and the Genesee river to Rochester, and through

the Genesee river feeder, in the city of Rochester, into the canal. The Tonawanda and Oak Orchard feeder and the Genesee river assist in filling the canal in the spring. The water from Allen's creek, at Scottsville, which is taken into the feeder at Rochester, tends to keep the water in the feeder pure through the summer months.

Since care has been taken to use as little water as possible below Newark in locking boats, no difficulty has been experienced in keeping up the levels at the lower end of the division.

Dams.

There are six dams on the division, as follows:

First. One across Tonawanda creek near its mouth. It raises the water in the creek about four feet above the level of Niagara river.

Second. One across the same creek south of Medina. Its purpose is to turn the water of the creek into the feeder and through it into the channel of Oak Orchard creek, and from thence into the canal at Medina.

Third. One across Allen's creek, in the village of Scottsville, to send the water through the Genesee Valley canal, which is now used as a feeder from Scottsville to Rochester.

Fourth. One across the Genesee river, in Rochester, to turn the water of that stream into the feeder.

Fifth. One across Oil creek, near the village of Cuba, Allegany county, to hold the water of that creek and form a reservoir. It is composed of earth, faced with rip-rap and slope wall, and is 2,200 feet long and sixty-five feet in height where it crosses the stream.

Sixth. One across a valley two miles from the last-mentioned ones. It has a waste-wier, composed of stone, to serve as an escape for the water of the creek when the reservoir is full.

Locks.

There are twenty-three locks on this division and all lock down toward tide-water.

LOCATION.	Lift in feet.
No. 53. One and one-fourth miles west of Clyde (lengthened)	4.755
No. 54. At Lock Berlin (lengthened)	7.360
No. 55. In the village of Lyons (lengthened)	6.251
No. 56. Poorhouse, one and seven-tenths miles west of Lyons lock (lengthened)	9.848
No. 57. Lower lock at Lockville, near Newark (not lengthened)	8.028
No. 58. Middle lock at Lockville, near Newark (not lengthened)	8.004
No. 59. Upper lock at Lockville, near Newark (not lengthened)	8.002
No. 60. Eight-tenths of a mile east of Macedon lock (lengthened)	9.886
No. 61. In the village of Macedon (lengthened	6.601
No. 62. Two and one-quarter miles west of Pittsford (lengthened)	8.807
No. 63. Miller's, in the village of Brighton (lengthened)	8.719
No. 64. Sipple's, in the village of Brighton (lengthened)	10.108
No. 65. Reservoir, in the city of Rochester (lengthened)	10.102
No. 66. First lock in the city of Rochester (lengthened)	8.859
Nos. 67-71. Five combined locks, as Lockport (not lengthened)	57.427
One guard-lock at Sulphur Springs. It has one chamber, 110 by twenty feet, and two additional head-gates. These gates are closed when a flood occurs in Tonawanda creek; otherwise they are left open.	
One river lock at Tonawanda, connecting the Niagara river with canal. The lift is generally four feet, depending on height of water in the river.	
One double-chamber guard and lift-lock (lengthened) at Black Rock (No. 72); it is 112 by twenty feet. The lift, together with the fall in the harbor from the canal below the mean low water in the lake, is	2.425
Total lift	175.182

By adding to the above lifts the surface descent on the different levels we get the total descent on the division.

On Montezuma level	.196
On twelve mile level, No. 59 to 60	.165
On seventeen mile level, No. 61 to 62	.343
On three mile level, No. 62 to 63	.063
On long level, Rochester to Lockport, No. 66 to 67	3.165
On level between Lockport and Black rock	1.239
	5.171
Total rise going west	180.353

There is also one single chamber ship-lock from Black Rock harbor to the Niagara river, it is 200x36 feet. The lift is usually four feet, according to the height of water in the lake and river.

The weight-lock in the city of Rochester, not now used as such for some years.

Repairs to locks.

New gates inserted in center of chamber lock No. 61 and towpath lock No. 65.

Balance beams renewed on Nos. 54 and 55 and new paddles inserted in gates.

Tumble-gate platforms on Nos. 53, 54, 56 and 58 were repaired.

A new crib was built at head of No. 61.

Chambers and culvert partly regrouted and replanked also miter-sills and paddles repaired in Nos. 62 and 63.

Apron in towpath No. 64 replanked and pair of gates and new paddles inserted.

Lower apron partly replanked with other repairs, No. 65.

Gates repaired T. P. New tumble-gates and platform partly rebuilt also new paddles inserted, No. 66.

New gates (three pair) inserted in No. 68 and No. 71, (one pair).

The ordinary repairs were made to combined locks Nos. 67 to 71.

The wooden pier at head of No. 71, has been extended 180 feet and now connects with Cottage street bridge, masonry No. 162, Lockport.

New paddles were put in ship-lock and guard-lock No. 72, also Tonawanda river lock, owing to extreme low water in the lake it was found necessary to keep the gates of No. 72, at Black Rock open the greater part of the season so as to give sufficient depth of water in Tonawanda creek and Lockport level—heretofore it was very unusual to open the gates—except for boats.

Repairs to locks needed.

One set of gates, one new miter-sill and lining to towpath No. 53.

Two new tumble-gate platforms No. 56.

One set of gates and two tumble-gate platforms, Nos. 57 and 59.

One new crib at head of No. 58.

The south wall at 71 requires to be taken down and rebuilt, it is pushing out of line by the action of frost and water from State race running through the joints (this was recommended in last years report).

The ship lock at Black Rock requires pointing and resetting some coping.

Aqueducts.

Floor and joists of Palmyra aqueduct renewed, the water leaks through the masonry and sides of trunk, the trunk should be renewed and necessary repairs made to masonry and foundation.

The Rochester aqueduct requires bottom cemented and sides pointed (recommended in last report). The towpath has been replanked (970 feet in length) and guard rail renewed. The Medina aqueduct has been partially repaired but requires more to be done to stop leaking.

Bridges.

There are 114 bridges of cast-iron; 50 of wrought-iron; 21 of wood and iron and 37 of wood, making 222 over Erie canal, slips 1, 2 and 3; Ohio and Commercial slips; Hamburgh and Clark and Skinner canals in the city of Buffalo; this is two more than last year's report; the increase is on account of bridge 169, highway and change towpath at Pendleton being called one (these are two independent of each other) and a new lift at Caledonia avenue, Rochester.

There is also a pipe-truss (cast-iron) over Oak Orchard creek feeder on Batavia road, Orleans county, which makes 223 in all. (See table of bridges.)

Repairs have been made on floors of Nos. 1, 2, 7, 8, 10, 12, 14, 16, 17, 22, 28, 31 and 32, and new floor joists in 38 and 39.

Wooden bridge No. 6 has been renewed.

Wooden bridge No. 42 has been condemned and should be renewed.

Wooden bridge No. 52. New floor-beams inserted and partially replanked.

Nos. 48, 65, 69, 76 and 87 have had new joists and roadway replanked.

No. 59. Replaced by new with iron lower chord formerly used in 104.

No. 76 1-2. A new lift was built at Caledonia avenue, Rochester.

Nos. 88, 93 and 94. New floor-beams inserted and replanked.

No. 95. Replaced by a whipple-iron arch, taken from Brockport.

No. 108. Some repairs and new counter weights were put in lift-bridge, Brockport, at the southeast and northwest panels to hold up part of the roadway on account of skew.

Wood and iron bridge No. 123 has been renewed.

Nos. 139, 140, 141, 145, 153, 157, 164 and 165. New joists and replanked.

New bents put in under No. 167 and guard-rail repaired, the bridges (two) of wood, extending north and south of iron one to top of bank in bad condition and requires renewal. This is in the deep cut above Lockport.

Wooden bridge, No. 168, over Sulphur Springs, guard-lock, has had new bents under same and new joists and plank where required.

Whipple-iron arch truss, No. 191, had fallen into canal at Amherst street, Black Rock, on March third, by reason of the carelessness of some person who wished to draw a building over it and finding the upper beams acting as struts on top of arch, being too low, unscrewed the nut of vertical rod, thereby causing it to fall. It was sent to State yard at Rochester, repaired there and is now on abutments in as good condition as it ever was.

Wood and iron bridge, No. 171, three spans, used as a towpath over Tonawanda creek, at Pendleton, has been renewed, owing to three horses abreast drawing boats, the roadway was made wider, giving twelve and one-half feet on the new to eleven feet on the old.

Bridge masonry.

The berme abutment to bridge No. 38 was found unsafe; it was rebuilt before the opening of navigation.

Towpath bridge No. 42. Abutment is leaning outward and should be rebuilt as recommended in last report.

A large amount of work is necessary to make repairs on abutments. Many stones are displaced by boats striking the wings; they should be protected by piles at end; this was mentioned in last report.

Culverts.

A great number of culverts require repairs to the masonry, also the dive culverts are filled with debris, so the water can not pass freely through them; this was recommended in last report.

Bulkheads and waste-weirs.

Waste-weir No. 3, east of Lyons, has been thoroughly repaired.

Waste-weirs, Nos. 1 and 2, should have masonry grouted and repointed.

Waste-weir at Holley repaired and those at Lockport, Medina and Brockville rebuilt.

The bulkhead at Tonawanda dam requires renewal as the timber is much decayed.

Vertical walls.

About eighty feet west of bridge 32, and seventy feet west of bridge 40, has fallen into canal; they should be rebuilt before navigation opens.

One hundred feet of new wall and sixty feet of twist was built from foot of lock 63, and extended easterly towpath side, to give a better alignment for boats to enter and depart.

A large amount of masonry is necessary to put the walls in good repair, especially through the city of Rochester.

Slope walls.

The walls are not in good condition for some distance west of Rochester. They are in fair condition east to Wayne county line.

Canal banks.

A large amount of material was excavated from the prism before opening of navigation. The towpath and berme banks were in good condition. Owing to low water in Lake Erie some interruption to navigation had occurred between Lockport and Buffalo. There seems to be some obstruction in canal between Pennsylvania street and east of State yard; at the time of deepening some years ago points and ledges of rock had not been taken out to the proper depth, and this is the cause of boats striking, the water being so low; none has occurred from Lockport east.

This division has been under the charge of John Bisgood and F. N. Kimball, as division and resident engineers respectively.

Very respectfully.

JOHN BISGOOD,
Division Engineer.

Statement giving names, rank, number of days and compensation of engineers upon the repairs of the Western Division of the New York State canals, with incidental expenses, during the fiscal year ending September 30, 1891, *from October* 1, 1890, *to September* 30, 1891.

ORDINARY REPAIRS — ERIE CANAL.

NAME.	Rank.	Number of days, etc.	Rate of compensation.	Total Amount.
John Bisgood	Division engineer	1 year	$2,400 per year	$2,400 00
John Bisgood	Division engineer	Expenses		215 48
F. N. Kimball	Resident engineer	248 days	2,000 per year	1,357 88
F. N. Kimball	Resident engineer	Expenses		123 52
M. W. Wilbur	Leveler	236 days	4 50 per day	1,062 00
M. W. Wilbur	Leveler	Expenses		82 16
D. R. Lee	Leveler	9 days	4 50 per day	40 50
W. T. Leighton	Leveler	46 days	4 50 per day	207 00
W. T. Leighton	Leveler	Expenses		2 64
J. B. Barrett	Rodman	244 days	3 50 per day	854 00
J. B. Barrett	Rodman	Expenses		102 53
Henry Geck	Chainman	300 days	2 50 per day	750 00
Henry Geck	Chainman	Expenses		48 69
D. M. Teller	Chainman	146 days	2 50 per day	365 00
D. M. Teller	Chainman	Expenses		30 87
				$7,687 22
Incidental expenses.				
Stationery			$139 81	
Fuel, light and office rent			403 20	
Postage and telegraph			69 65	
Telephone			64 00	
Miscellaneous account			199 89	
				876 55
Total				$8,813 77

EXTRAORDINARY REPAIRS — SURVEY COURT OF CLAIMS.

Act chapter 302, *Laws of* 1891.

NAME.	Rank.	Number of days, etc.	Rate of compensation.	Total amount.
F. N. Kimball	Resident engineer	18 days	$2,000 per year	$98 90
F. N. Kimball	Resident engineer	Expenses		39 70
M. W. Wilbur	Leveler	22 days	4 50 per day	99 00
M. W. Wilbur	Leveler	Expenses		25 71
W. T Leighton	Leveler	20 days	4 50 per day	90 00
W. T. Leighton	Leveler	Expenses		1 64
J. B. Barrett	Rodman	13 days	3 50 per day	45 50
J. B. Barrett	Rodman	Expenses		24 52
D. M. Teller	Chainman	9 days	2 50 per day	22 50
D. M. Teller	Chainman	Expenses		15 74
Total				$463 21

EXTRAORDINARY REPAIRS — BOTTOMING OUT ERIE CANAL.

Act chapter 168, *Laws of* 1890.

NAME.	Rank.	Number of days, etc.	Rate of compensation.	Total amount.
F. N. Kimball	Resident engineer	30 days	$2,000 per year	$164 84
F. N. Kimball	Resident engineer	Expenses		60 73
M. W. Wilbur	Leveler	26 days	4 50 per day	117 00
M. W. Wilbur	Leveler	Expenses		32 68
J. B. Barrett	Rodman	26 days	3 50 per day	91 00
J. B. Barrett	Rodman	Expenses		36 91
Henry Geck	Chainman	3 days	2 50 per day	7 50
Henry Geck	Chainman	Expenses		3 54
D. M. Teller	Chainman	5 days	2 50 per day	12 50
D. M. Teller	Chainman	Expenses		10 45
Total				$537 15

EXTRAORDINARY REPAIRS — TONAWANDA BRIDGE.

Act chapter 82, *Laws of* 1891.

NAME.	Rank.	Number of days, etc.	Rate of compensation.	Total amount.
F. N. Kimball	Resident engineer	12 days	$2,000 per year	$65 22
F. N. Kimball	Resident engineer	Expenses		43 70
M. W. Wilbur	Leveler	12 days	4 50 per day	54 00
M. W. Wilbur	Leveler	Expenses		43 70
W. T. Leighton	Leveler	60 days	4 50 per day	270 00
W. T. Leighton	Leveler	Expenses		16 55
J. B. Barrett	Rodman	11 days	3 50 per day	38 50
J. B. Barrett	Rodman	Expenses		39 40
D. M. Teller	Chainman	14 days	2 50 per day	35 00
D. M. Teller	Chainman	Expenses		47 70
				$653 77
	Incidental expenses.			
Miscellaneous account				10 72
Total				$664 49

EXTRAORDINARY REPAIRS — EXAMINATION AND MAPS.

Act chapter 295, *Laws of* 1890.

NAME.	Rank.	Number of days, etc.	Rate of compensation.	Total amount.
Michael Leonard	Gauge tender	63 days	$0 50 per day	$31 50
Michael Leonard	Gauge tender	Expenses		1 00
Total				$32 51

EXTRAORDINARY REPAIRS — CALEDONIA AVENUE BRIDGE, ROCHESTER, N. Y.

Act chapter 117, *Laws of* 1890.

NAME.	Rank.	Number of days, etc.	Rate of compensation.	Total amount.
F. N. Kimball	Resident engineer	27 days	$2,000 per year	$149 39
F. N. Kimball	Resident engineer	Expenses		4 26
M. W. Wilbur	Leveler	9 days	4 50 per day	40 50
J. B. Barrett	Rodman	13 days	3 50 per day	45 50
Henry Geck	Chainman	6 days	2 50 per day	15 00
D. M. Teller	Chainman	39 days	2 50 per day	97 50
Total				$352 15

EXTRAORDINARY REPAIRS — SURVEY COURT OF CLAIMS.

Act chapter 295, *Laws of* 1890.

NAME.	Rank.	Number of days, etc.	Rate of compensation.	Total amount.
F. N Kimball	Resident engineer	9 days	$2,000 per year	$48 91
F. N. Kimball	Resident engineer	Expenses		35 39
M. W. Wilbur	Leveler	9 days	4 50 per day	40 50
M. W. Wilbur	Leveler	Expenses		10 90
D. R. Lee	Leveler	1 day	4 50 per day	4 50
D. R. Lee	Leveler	Expenses		4 92
J. B. Barrett	Rodman	18 days	3 50 per day	28 00
J. B. Barrett	Rodman	Expenses		18 38
Henry Geck	Chainman	4 days	2 50 per day	10 00
Henry Geck	Chainman	Expenses		2 74
Total				$204 24

EXTRAORDINARY REPAIRS — DREDGING CHAUTAUQUA OUTLET.

Act chapter 167, *Laws of* 1890.

NAME.	Rank.	Number of days, etc.	Rate of compensation.	Total Amount.
F. N. Kimball	Resident engineer	21 days	$2,000 per year	$114 91
F. N. Kimball	Resident engineer	Expenses		72 43
W. T. Leighton	Leveler	80 days	4 50 per day	360 00
W. T. Leighton	Leveler	Expenses		22 94
D. M. Teller	Chainman	102 days	2 50 per day	255 00
D. M. Teller	Chainman	Expenses		52 65
J. G. Glendon	Boatman	90 days	2 00 per day	180 00
				$1,057 93
Incidental expenses.				
Office rent			$32 50	
Boat hire			30 00	
				62 50
Total				$1,120 42

SUMMARY OF ENGINEERING EXPENSES UPON THE WESTERN DIVISION, NEW YORK STATE CANALS, FOR THE FISCAL YEAR ENDING SEPTEMBER 30, 1891.

Extraordinary repairs:

	Amount.
Examination and maps, chapter 295, Laws 1890	$32 50
Survey for Court of Claims, chapter 295, Laws 1890	204 24
Survey for Court of Claims, chapter 302, Laws 1891	463 21
Caledonia avenue bridge, chapter 117, Laws 1890	352 15
Tonawanda bridge, chapter 82, Laws 1891	664 49
Bottoming out canal, chapter 168, Laws 1890	537 15
Dredging Chautauqua Lake outlet, chapter 167, Laws 1890.	1,120 43
Ordinary repairs	8,513 77
Total engineering expenses for Western Division	$11,887 94

ERIE CANAL.

List of bridges on Western Division.

Number.	CAST-IRON.					WROUGHT-IRON.						WOOD AND IRON.	WOOD.		Remarks.
	Whipple arch.	Whipple trapezoidal.	Bollman.	Swartz.	Pipe.	Cooper's arch.	Bowstring.	Lattice.	Lift.	Swing.	Roof.	Whipple.	Whipple.	Draw.	
1	......	......	......	......	......	......	......	......	......	......	......	1	......	......	Wayne county line.
2	......	......	......	......	......	......	......	......	......	......	......	......	1	......	Pit lock.
3	1	......	......	......	......	......	......	......	......	......	......	......	......	......	Waldruffs.
4	......	......	......	......	......	......	......	......	1	......	......	......	......	......	Glasgow street, Clyde.
5	1	......	......	......	......	......	......	......	......	......	......	......	......	......	Sodus street, Clyde.
6	......	......	......	......	......	......	......	......	......	......	......	......	1	......	Sigman's.
7	......	......	......	......	......	......	......	......	......	......	......	......	1	......	Barker's.
8	......	......	......	......	......	......	......	......	......	......	......	......	1	......	Long's.
9	......	......	......	......	......	......	......	1	......	......	......	......	......	......	Lock Berlin.
10	1	......	......	......	......	......	......	......	......	......	......	......	......	......	Horton's.
11	......	......	......	......	......	......	......	......	......	......	......	1	......	......	Goetzman's.
12	......	......	......	......	......	......	......	......	......	......	......	......	1	......	Klau's.
13	......	......	......	......	......	......	......	......	......	......	......	......	1	......	Richmond's.
14	......	......	......	......	......	......	......	1	......	......	......	......	......	......	Cole's.
15	1	......	......	......	......	......	......	......	......	......	......	......	......	......	Geneva street, Lyons.
16	1	......	......	......	......	......	......	......	......	......	......	......	......	......	Church street, Lyons.
17	1	......	......	......	......	......	......	......	......	......	......	......	......	......	Water street, Lyons.
18	1	......	......	......	......	......	......	......	......	......	......	......	......	......	Leach's.
19	......	......	......	......	......	......	......	......	......	......	......	......	1	......	Prine's.
20	......	......	......	......	......	......	......	1	......	......	......	......	......	......	Park's.
21	......	......	......	......	......	......	......	1	......	......	......	......	......	......	Mosher's.
22	......	......	......	......	......	......	1	......	......	......	......	......	......	......	Towpath change.
23	1	......	......	......	......	......	......	......	......	......	......	......	......	......	Lockville.
24	1	......	......	......	......	......	......	......	......	......	......	......	......	......	Charles street, Newark.
25	1	......	......	......	......	......	......	......	......	......	......	......	......	......	Main street, Newark.
26	1	......	......	......	......	......	......	......	......	......	......	......	......	......	Allerton's.
27	1	......	......	......	......	......	......	......	......	......	......	......	......	......	Peck's.
28	......	......	......	......	......	......	......	......	......	......	......	......	1	......	Sweezey's.
29	......	......	......	......	......	......	......	......	......	......	......	......	1	......	Palmer's.
30	1	......	......	......	......	......	......	......	......	......	......	......	......	......	Port Gibson.
31	......	......	......	......	......	......	......	1	......	......	......	......	......	......	Galloway's.

31½	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Kent street.
32	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Railroad avenue, Palmyra.
33	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Market street, Palmyra.
34	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Church street, Palmyra.
35	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	Towpath change, Palmyra.
36	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	Crandall's.
37	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	Clark's.
38	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	White's.
39	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	Towpath change and highway, Macedon.
40	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Macedon.
41	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	Frear's.
42	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	Wayneport.
43	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	Knapp's.
44	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	Baker's.
45	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	Parker's, Fairport.
46	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Main street, Fairport.
47	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	Fullam's Basin.
48	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	Wapping.
49	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Wiltsie's.
50	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Bushnell's Basin.
51	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	Cartersville.
52	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	Guernsey's.
53	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Pittsford.
54	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Main street, Pittsford.
55	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Sutherland's.
56	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	Cook's.
57	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	Weed's.
58	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Billinghurst's.
59	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	Donnelly's.
60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	Drake's.
61	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Brighton.
62	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	Culver road.
63	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	Monroe avenue, Rochester.
64	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Goodman street, Rochester.
65	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	Nelson street, Rochester.
66	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Averill street, Rochester.
67	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Alexander street, Rochester.
67½	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	Pinnacle avenue, Rochester.
68	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	St. Paul street, Rochester.
69	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	Griffith street, Rochester.
70	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	Tow-path change, Rochester.
71	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Court street, Rochester.
73	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	Exchange street, Rochester.
74	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Fitzhugh street, Rochester.
76	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Washington street, Rochester.
76½	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	Caledonia avenue, Rochester.
77	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	West avenue, Rochester.
78	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Ford street, Rochester.
79	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	Towpath over Genesee Valley canal, Rochester.
82	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Jay street, Rochester.

ERIE CANAL — *List of bridges, etc.* — (*Continued*).

Number.	CAST-IRON.					WROUGHT-IRON.						WOOD AND IRON.	WOOD.		Remarks.
	Whipple arch	Whipple trapezoidal.	Bollman.	Swartz.	Pipe.	Cooper's arch.	Bowstring.	Lattice	Lift.	Swing.	Roof.	Whipple.	Whipple.	Draw	
85			1												Emerson street, Rochester.
86	1														Rowe street, Rochester.
87							1								Towpath change.
88												1			Scott's.
89													1		Four-mile grocery.
90												1			Spier's.
91		1													Six-mile grocery.
92													1		Douglas'.
93												1			Finley's.
94												1			South Greece.
95	1														Cromwell's.
96	1														Hiscock's.
97												1			Norman's.
98	1														Union street, Spencerport.
99	1														Amity street, Spencerport.
100	1														Webster's, east.
101													1		Webster's, west.
102		1													Cressy's, Adams Basin.
103	1														Adams Basin.
104	1														Doty's.
105	1														Brockway's.
106	1														Cooley's Basin.
107	1														Mechanic street, Brockport.
108									1						Main street, Brockport.
109	1														Smith street, Brockport.
110	1														Danforth's.
111								1							Miner's.
112	1														County line, Monroe and Orleans.
113							1								Orr's.
114	1														Frisby's, old canal, Holley.
115	1														Holley.
116	1														McCarty's.
117				1											Tuttle's.
118												1			McGuire's.
119	1														Hulberton.

120	1														Brockville.
121	1														Hindsburgh.
122							1								Transit road.
123												1			Jaquith's.
124													1		Bidwell's.
125				1											Brailey's.
126	1														Hall's.
127			1												Ingersoll street, Albion.
128										1					Batavia street, Albion.
129													1		Lattin's.
130								1							Gaines Basin.
131	1														Eagle Harbor.
132													1		Starkweather's.
133	1														Allen's.
134													1		Long's.
135	1														Knowlesville.
136													1		Beal's.
137	1														Hasting's.
138	1														Holloway's, Medina.
139	1														Church street, Medina.
140	1														Shelby street, Medina.
140½								1							Prospect street, Medina.
141													1		Jackson's.
142								1							Shelby Basin.
143													1		Town line
144													1		Vernon street, Middleport.
145	1														Main street, Middleport.
146								1							Williams'.
147													1		Watson's
148								1							Hurd's.
149													1		Reynales' Basin.
150	1														Mabee's.
151								1							Gasport.
152	1														Orangeport.
153	1														Millard's.
154													1		Wakeman's.
155	1														Young's, Lockport.
156	1														Comstock's, Lockport.
157	1														Adams street, Lockport.
158	1														Chapel street, Lockport.
159			1												Exchange street, Lockport.
160												1			Cady's, Lockport.
161		1													Pine street, Lockport, two spans.
162											1				Cottage street, Lockport.
163											1				Main street, Lockport.
164	1														Transit road, Lockport.
164½								1							Prospect street, Lockport.
165	1														Hitchins'.
166	1														Heacox's, one iron and two wood spans.
167		1													Hawley's, one iron and two wood spans.

ERIE CANAL — *List of bridges, etc.* — (*Continued*).

Number.	CAST-IRON.					WROUGHT-IRON.						WOOD AND IRON.	WOOD.		Remarks.
	Whipple arch.	Whipple trapezoidal.	Bollman.	Swartz.	Pipe.	Cooper's arch.	Bowstring.	Lattice.	Lift.	Swing.	Roof.	Whipple.	Whipple.	Draw.	
168													1		Sulphur Springs lock, three wood spans.
169		1													Pendleton highway.
169					1										Towpath change, Pendleton.
170					1										Old canal, Pendleton.
171												1			Towpath over Tonawanda creek, three spans, Pendleton.
172													1		Ransom creek, towpath.
173												1			New Home, two spans.
174												1			Pickard's, two spans wood and iron and one wood.
175							1								Bush's.
176	1														Towpath, Ellicott creek Tonawanda.
177								1							Main street, Tonawanda.
178	1														River lock slip, Tonawanda.
179	1														Seymour street, Tonawanda.
180			1												Bouck street, Tonawanda.
181					1										Towpath change, Tonawanda.
182	1														Grand Island ferry, Tonawanda.
183												1			Three mile.
184												1			Cherry's.
185													1		Lineberg's.
186	1														Scott's, Grand Island ferry.
187					1										Towpath change, Black Rock.
188							1								Towpath lift, north side canal (Swartz) Black Rock.
189	1														Bird street, Black Rock.
189½								1							Austin street, Black Rock.
190						1									Highway and change, Black Rock.
191	1														Amherst, Black Rock.
192													1		Mill street, Black Rock.
193														1	Scajaquada creek, Black Rock.
194								1							Ferry street, Black Rock.
195										1					Ferry street over Buffalo harbor, Black Rock.
196								1							York street, towpath change and highway, Buffalo.
196½								1							Hudson street, Buffalo.
197	1														Georgia street, Buffalo.
198	1														Towpath slip No. 8, Buffalo.

199	......	......	......	......	......	......	......	......	......	......	......	......	......	1	Wilkinson slip, Buffalo.
200	......	......	......	......	......	......	......	1	......	......	......	......	......	......	Genesee street, Buffalo.
201	1	......	......	......	......	......	......	......	......	......	......	......	......	......	Towpath slip No. 2, Buffalo.
202	......	......	......	......	......	......	1	......	......	......	......	......	......	......	Towpath slip No. 1, Buffalo.
203	1	......	......	......	......	......	......	......	......	......	......	......	......	......	Erie street, Buffalo.
204	......	......	......	......	......	......	......	1	......	......	......	......	......	......	Commercial street, Buffalo.
207	......	......	......	......	......	......	......	1	......	......	......	......	......	......	Lloyd street, Buffalo.
	82	5	6	3	7	2	8	27	4	3	2	21	85	2	

ERIE CANAL — *List of bridges, etc.* — (Concluded).

COMMERCIAL SLIP, BUFFALO.

Number.	CAST-IRON.	Remarks.
	Whipple arch.	
205	1	Canal street
206	1	Prince street
....	......	
....	......	
....	2	

OHIO SLIP, BUFFALO.

Number.	CAST-IRON.	WROUGHT-IRON.		Remarks.
	Whipple arch	Swing.	Bowstring.	
217	1	....	....	Perry street.
218	1	....	....	Fulton street.
219	....	....	1	Elk street.
220	....	1	...	Ohio street.
....	2	1	1	

HAMBURGH CANAL, BUFFALO.

Number.	CAST-IRON.	WROUGHT-IRON.	Remarks.
	Whipple arch.	Lattice.	
208	1	....	Main street
209	....	1	Washington street
214	1	....	Michigan street
215	1	....	Chicago street
216	....	1	Louisiana street
....	3	2	

CLARK AND SKINNER CANAL, BUFFALO.

Number.	CAST-IRON.		Remarks
	Whipple arch.	Bollman.	
210	1	....	Scott street.
211	1	....	Perry street.
212	....	1	Elk street.
213	....	1	Ohio street.
....	....	....	
....	2	2	

SUMMARY.

	CAST-IRON.					WROUGHT-IRON.						WOOD AND IRON.	WOOD.		
	Whipple arch.	Whipple trapezoidal.	Bollman.	Swartz.	Pipe.	Cooper's arch.	Bowstring.	Lattice.	Lift.	Swing.	Roof	Whipple.	Whipple	Draw.	Total.
Erie canal	82	5	6	3	7	2	8	27	4	3	2	21	35	2	207
Commercial slip	2	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Hamburgh canal	3	....	....	....	....	....	....	2	....	...	...	....	....	..	5
Clark and Skinner canal	2	....	2	....	....	....	....	....	...	....	....	....	....	....	4
Ohio slip	2	....	....	....	....	....	1	....	....	1	....	....	....	....	4
Oak Orchard creek feeder, on Batavia road, Orleans county	....	....	....	....	1	....	....	....	....	....	....	....	....	....	1
	91	5	8	3	8	2	9	29	4	4	2	21	35	2	223

APPENDIX E.

EXTRACTS FROM REPORT OF OBSERVATIONS ON TRANSPORTATION UPON THE NEW YORK STATE CANALS, THE HUDSON RIVER AND OTHER CONNECTING WATERWAYS, WITH NOTES UPON TRANSPORTATION ON THE ILLINOIS AND MICHIGAN CANAL AND UPON COAL BOAT TOWAGE ON THE OHIO AND MISSISSIPPI RIVERS, MADE UNDER THE DIRECTION OF JOHN BOGART, STATE ENGINEER, BY AUG. S. KIBBE, ASSISTANT ENGINEER.

ALBANY, N. Y., *December* 31, 1891.

HON. JOHN BOGART, *State Engineer:*

Sir.— In accordance with your instructions I have the honor to present the following report upon transportation upon the canals of the State of New York, with notes upon transportation at other points.

Respectfully.

AUG. S. KIBBE.
Assistant Engineer.

Canal Transportation, 1891.

Prior to the completion of the Erie canal in 1825, transportation was conducted upon toll roads at rates which were almost prohibitory to commerce. The prices of transportation during the years 1817, 1818 and 1819, by teams from Albany to Buffalo, were 29.3 cents per ton of 2,000 pounds per mile.* On the Erie canal, in 1835, the rates, including tolls, were as follows: Merchandise, three dollars and ninety-five cents per ton per mile; flour, one dollar and eighty-three cents per ton per mile; staves, ninety-

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* **State Engineer's Report for 1862. Assembly Document No. 8, 1863.**

seven cents per ton per mile; salt, ninety-three cents per ton per mile.

To-day grain is transported from Buffalo to New York, over the canal and Hudson river, for three-tenths cent per ton per mile, freight charge, a reduction of nearly ninety-nine per cent from the rates in 1817-18-19.

The successive steps by which this result has been attained are of great interest.

The canal was constructed with a waterway forty feet wide at surface, twenty-eight feet wide at bottom and four feet deep. The lock-chambers were ninety feet long and fifteen feet wide. So rapidly did the traffic increase that, nine years after the completion of the canal, its enlargement was discussed and the cost estimated. Ten years after completion, in 1835, the enlargement was authorized and the dimensions of new canal fixed as follows: Surface width, seventy feet; depth of water, seven feet; lock-chambers, 110 feet by eighteen feet, all locks to be double; the estimated effect of this change being a saving of one-half in cost of transportation, exclusive of tolls.

This enlargement was practically completed in 1862. The next step taken by the State consisted in the abolition of tolls. By an amendment to the Constitution, which took effect January 1, 1883, it was provided that "no tolls shall hereafter be imposed on persons or property transported on the canals.".

During the winter of 1884-5 the experiment was made of lengthening one of the double locks to admit of the entrance of two boats at once, and the same enlargement has been made of thirty-seven other locks.

In addition to this, much has been done to perfect the water supply, to maintain the full depth of water and in a large number of the locks machinery has been placed to assist boats into and out of, the chamber, in order that delays due to locking might be minimized.

The above summarizes briefly the improvements made by the State to stimulate canal traffic and to facilitate transportation. Improvements in methods of construction, equipment and management of boats have kept pace with and, in fact, prompted those in the condition of the waterway.

The first boats carried about thirty tons, while to-day there are many which will hold 250 tons, while the great bulk of the traffic is carried on in boats carrying 240 tons. While on some other waterways, notably the Delaware and Raritan canal, it has been found that the average boat load was only about one-third of what the dimensions of the locks would permit, the experience on the Erie canal has been entirely in the other direction. The dimensions of the boats have kept pace with every improvement in locks or prism, and to such an extent that great difficulty is experienced in entering and leaving locks and in traversing levels where the water may be temporarily lowered a few inches, while a boat that is not handled with great care when descending through a lock, will jam the lower gate and cause considerable delay before being released. Thus it is apparent that the maximum dimensions of length, breadth and draft are adhered to, in spite of such inconveniences, and this would hardly be the case, after so extended an experience, had not considerations of economy dictated such a course.

But, without exception worthy of record, no improvement was made in the propelling power employed, prior to the year 1871. Steam tugs were used at the termini of the canal and more or less local traffic carried on in small steamers, but transportation was effected with horses and mules as the propelling agents from the inception of the canal system up to the above-mentioned date.

Steam on the Canals, 1871-2-3-4.

The first impetus given to the construction and use of steam canal boats especially designed for use on the Erie canal, was afforded by the passage of the following law:

CHAPTER 868.— LAWS OF 1871.

AN ACT to foster and develop the internal commerce of the State by inviting and rewarding the practical and profitable introduction upon the canals of steam, caloric, electricity, or any motor other than animal power, for the propulsion of boats.

PASSED April 28, 1871; three-fifths being present.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. George B. McClellan, Horatio Seymour, Erastus S. Prosser, David Dows, George Geddes, Van R. Richmond, Willis

S. Nelson, George W. Chapman, William W. Wright and John D. Fay, are hereby appointed a commission to practically test and examine inventions, or any and all devices which may be submitted to them for that purpose, by which steam, caloric, electricity, or any other motor than animal power, may be practically and profitably used and applied in the propulsion of boats upon the canals; said examination and tests shall be had by the said commissioners at such time or times during the season of canal navigation, for the years eighteen hundred and seventy-one and seventy-two, as they may order and direct; said commissioners shall have the right, and they are hereby expressly required, to reject all such inventions or devices, if, in their opinion, none of the said inventions or devices shall fully and satisfactorily meet the requirements of this act; but said commissioners shall demand and require: First, The inventions or devices to be tested and tried at their own proper costs and charges of the parties offering the same for trial. Second, That the boats shall, in addition to the weight of the machinery and fuel reasonably necessary for the propulsion of said boat, be enabled to transport, and shall actually transport, on the Erie canal, on a test or trial exhibition, under the rules and regulations now governing the boats navigating the canals, at least two hundred tons of cargo. Third, That the rate of speed made by said boat shall not be less than an average of three miles per hour, without injury to the canals or their structures. Fourth, That the boat can be readily and easily stopped or backed by the use and power of its own machinery. Fifth, That the simplicity, economy and durability of the invention or device must be elements of its worth and usefulness. Sixth, That the invention, device or improvement can be readily adapted to the present canal boats; and, lastly, that the commissioners shall be fully satisfied that the invention or device will lessen the cost of canal transportation and increase the capacity of the canals. Any means of propulsion or towage other than by a direct application of power upon the boat, which does not interfere in any manner with the present method of towage, on the canals, and complying in all other respects with the provisions of this act, may be entitled to the benefits thereof; but this shall not be construed to apply to the system known as the Belgian system, or to any mode of propulsion by steam-engines or otherwise upon either bank of the canals.

§ 2. No such test shall be made if the same shall in any manner retard, hinder, or delay the passage of boats navigating the canals under the present system.

§ 3. If the commissioners herein appointed shall, upon such examination and test, as is provided for in the first section of this act, conclude and determine at any time, that one or more inventions or devices as aforesaid, but not to exceed three in number, shall be in all respects a full and satisfactory, practicable and profitable adaptation to the wants of the canals by reason of a new, useful and economical means of propulsion for boats within the meaning of this act, it shall then, and not otherwise, be their duty to grant unto the owner or owners of such invention or devices, his or their attorney, their certificate or certificates, under their hands as such commissioners, that they have so determined and adjudged; to the owner or owners of the invention or device which, in the judgment of the said commissioners, possesses in the greatest degree of perfection the requisites mentioned in the first section, they shall grant a certificate which shall be known as certificate number one; and to the owner or owners of the next best invention or device, they shall grant a certificate as aforesaid, which shall be known as certificate number two; and to the owner or owners of the third best invention or device, they shall grant a certificate as aforesaid, which shall be known as certificate number three.

§ 4. Before entering upon the duties of his office, each of the commissioners herein named shall take and subscribe an official oath, which shall be filed at once in the office of the secretary of state. Any vacancy arising from any cause in said commission, may be filled on the application of the remaining commissioners, by the governor.

§ 5. The reasonable expenses of the said commission, not exceeding in all the sum of five thousand dollars, to be determined by the said board, shall be paid out of any sum which may be awarded to the person or persons receiving the certificates mentioned in the third section of this act, in proportion to the amount awarded to the holders of said certificates, providing such certificates shall be granted and, if no such certificates shall be granted, then the same shall be paid by the treasurer on the warrant of the comptroller out of any moneys in the treasury not otherwise appropriated.

§ 6. Upon the production by the owner or owners, or his or their attorney, of such certificate or certificates as may be granted under the provisions of this act, to the comptroller, he shall draw his warrant upon the treasurer of the state of New York for the sum of fifty thousand dollars, payable to the said owner or owners of said invention, device, his or their attorney, out of any money in the treasury not otherwise appropriated, in case but one certificate shall have been granted by said commissioners. If two certificates shall have been granted and no more, the said comptroller shall draw his said warrant upon the said treasurer for the sum of thirty-five thousand dollars, payable to the owner or owners of certificate number one; and said comptroller shall also draw his said warrant upon the said treasurer for the sum of fifteen thousand dollars, payable to the owner or owners of certificate number two. If three certificates shall be granted by said commissioners, then and in that case the said comptroller shall draw his said warrant upon the said treasurer for the sum of thirty thousand dollars, payable to the owner or owners of certificate number one; and one of fifteen thousand dollars, payable to the owner or owners of certificate number two; and one of five thousand dollars, payable to the owner or owners of certificate number three.

§ 7. If on or before the first day of November, eighteen hundred and seventy-three, the commissioners hereinbefore named shall, upon due examination, find and determine that the said invention or device has been successfully operated upon the canals, and has been or will be largely adopted as a motor on said canals, by reason of its superiority over any other known method of propulsion, then and in such case they shall grant a further certificate of that fact, and the comptroller, upon its presentation to him, shall draw his warrant upon the treasurer of the state for the further sum of fifty thousand dollars, payable to the said owner or owners of the said device, his or their attorney, out of any money in the treasury not otherwise appropriated; but in case of the granting by said commissioners of more than one certificate, as stated in section six of this act, then and in that case the sum of fifty thousand dollars, mentioned in this section, shall be divided among and paid to the owners of the said certificates in the proportion and in the manner as stated in section six of this act.

The commission established by this act met and organized and appointed David M. Greene, Esq., civil and mechanical engineer, engineer to the commission:

The following resolutions were adopted for the guidance of competitors:

Resolved, That for the purpose of carrying out the intent of the law, this commission will require, among the tests to be made, that the several competitors shall make not less than three round trips, from New York and Buffalo or Oswego; each boat to be loaded with not less than 200 tons of cargo each way; the trips to be commenced as soon as any party is ready, and all completed in the least practicable time. For the purpose of determining the time consumed by each and all the trips, the clearance must show the day of the month and time of day that the boat passes each collector's office; certified copies thereof to be furnished to the commission. In order to obtain information in regard to the practical working of the several devices in competition, as soon as practicable, the engineer of the commission, Mr. David M. Greene, of Troy, will inspect the same from time to time, as in his judgment may be necessary, and report the facts obtained to this commission.

Resolved, That competitors are hereby notified that for the purpose of carrying out the intent of the law, that though it is desirable that the three consecutive round trips from Buffalo or Oswego to New York be made at the earliest time practicable, that the whole of the year 1872 will be allowed to such persons as may desire so much time, and that the awards will not be made until the close of navigation in that year.

In the first report of this commission,* mention is made of the impression almost universal among inventors that the great difficulty to be overcome in navigating the canals by loaded boats at the rate of three miles an hour, was the injury done to the banks by the swell caused by the boat and machinery, the result being the submission of a large number of models of new wheels or novel shapes of boats. The following resolution was adopted to obviate further waste of time or money:

Resolved, That the experiments heretofore made in navigating the canals by freight boats propelled by steam have not been failures by reason of injury done the banks of the canals by the swell caused either by the motion of the boat or the wheels through the water; and that, in the judgment of this commission, there is no practical difficulty in navigating the canals by boats carrying 200 tons of cargo, at the rate of three miles per hour, that arises from "injury to the canals or their structures." The main difficulty to be overcome is to establish the economy of steam or other motor as compared with animal power.

The wisdom of this conclusion has been amply demonstrated by experience. A fleet of full-sized boats to-day, coupled in pairs and passing through the water in the canal at the rate of three miles per hour, will barely cause the water to lap the banks, and the wake of one pair of boats has disappeared long before the following pair has reached the spot. The damage by wash is caused by smaller steamers traveling at much higher speed.

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* Assembly Document No. 61, 1872.

There was but one steamer brought to the official notice of the board during the first season, namely, the A. H. H. Dawson, concerning which the following facts were mentioned: Two round trips were made, loaded, with a maximum average speed through canal, for a single trip, exclusive of all detentions, of two miles per hour.

This boat was peculiar, in having the screw located in a cavity in the bow, forcing the water through a passageway underneath the boat. Her first season's work was evidently not a success.

Mr. Greene concluded his report with the following statement:

Former Attempts to Introduce Steam upon the Canals.

Diligent inquiry in various quarters has been made, with a view to obtain information in regard to the earlier efforts to introduce steam as a motive power on the canal.

No precise information in regard to the details of these efforts could, however, be obtained. Beyond the simple fact that the attempts proved unsuccessful, no satisfactory or useful record appears to have been preserved. For this reason the design originally entertained of presenting a detailed history of the earlier experiments and failures has been abandoned.

Season of 1872.*

The resolutions adopted in 1871 for guidance of competitors were modified by the following:

Resolved, That boats making the three round trips, from Buffalo or Oswego, the Hudson river and return, as heretofore required by this commission, for the purpose of determining the rate of speed of said boats, will not be required to continue the trips to New York city, nor to carry more than 100 tons of cargo going west, and that deductions from the time consumed in navigating the canals will be made for passing the locks, equal to twenty hours for each round trip from Buffalo, and proportional allowance will be made if the trial is from Oswego. In case of delays, growing out of obstructions to navigation that are caused by breaks in the canals, or injuries to the structures, or sunken boats, such as detain boats drawn by horses, the time lost will also be allowed for in computing speed.

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* Senate Document No. 71, 1873.

From the second report of the engineer it appears that twelve steamers undertook to accomplish the three round trips required, of which but three actually succeeded, although a fourth did an equivalent amount of work.

The steamers accomplishing the three round trips were as follows: The steamer "William Newman," built at Watkins, N. Y., weighing, light, seventy and three-quarter tons, carrying capacity, when drawing six feet of water, 214 tons. The machinery consisted of a single upright engine, twelve inches diameter and twelve-inch stroke. The screw was four-bladed, five feet in diameter, with seven feet pitch. The boiler was horizontal, return tubular, eight feet long and four feet in diameter.

The steamer "William Baxter" was built at Fishkill, N. Y., for the purpose of competing in the State trials. She weighed, light, 57.2 tons and had a theoretical carrying capacity of 207 tons. The machinery consisted of a compound condensing engine, the high and low-pressure cylinders standing on separate frames, one on each side of the upright boiler. The cylinders were seven and twelve inches in diameter, with a common stroke of twelve inches. The boiler was seven feet high and forty-six and a half inches in diameter.

The Baxter was peculiar in being propelled by two three-bladed screws, four and one-half feet in diameter with four feet pitch and the machinery could be controlled by the steersman. The hull was also of peculiar shape, as may be seen by reference to accompanying Plate III. See description of "City of New York."

The steamer "Port Byron" was built at Rochester, N. Y., and was peculiar in having a concave bow below water line, with a rectangular trunk along the bottom for the passage of water, terminating in the recess cut in the stern for the feathering paddle-wheel by which the steamer was propelled. This wheel was ten feet in diameter, with paddles of boiler iron three feet six inches long and two feet four inches wide; the axis of the shaft being eight inches above water, at six feet draft of boat. The engine was double, non-condensing, with cylinders twelve inches in diameter and twenty-four inches stroke.

Besides these boats the following competed:

The "A. H. H. Dawson," described above. The "Chas. Hemje," built in Buffalo, N. Y., weighed seventy-eight and three-quarter tons, light and carried about 201 tons. The motive power consisted of a single, upright, non-condensing engine, with cylinder fourteen inches in diameter and twelve inches stroke. The boiler was horizontal, return tubular, eight feet long and four feet nine inches in diameter. The screw was four bladed, four feet six inches in diameter, with six feet six inches pitch. The peculiarity of this boat consisted in a cylindrical casing of boiler iron, with a horizontal axis, but held on a vertical axis about the screw, and independent of it. This cylinder replaced the ordinary rudder, the boat being steered by the force of the water expelled through the cylinder by the action of the screw.

The steamer "Fountain City" was peculiar in the method of propulsion and steering, both these functions being performed by two stern paddle-wheels revolving toward each other about vertical axes.

The steamer "Excelsior" was an iron steamer of a type similar to the "Fountain City," but was found to be too frail for use in the canal.

The steamer "Eureka" was built of iron and carried her machinery forward, being propelled by two screws, located in the bow. This arrangement was found unsatisfactory.

The steamer "George A. Feeter" was provided with channelways in hull, for passage of water, shaped like a letter Y with the single arm pointing back, at the stern, the water entering the diagonals on either side of the boat. This boat made but one trip.

The steamer "Central City" was built for the competition in use, N. Y. The peculiar feature of this boat consisted in the adjustable paddle-wheels by which she was propelled. These were placed in recesses built in her sides, at the stern, and the whole machinery, wheels, boiler and engine rested upon a frame, supported by four vertical screws, by which the whole could be raised or depressed at will. Owing to lateness of completion this boat was able to make but a partial trip in 1872.

The "Montana" was propelled by a stern wheel, with feathering buckets, but performed very unsatisfactorily.

To afford a general conception of what was accomplished during this season, 1872, the following table has been prepared from the detailed reports by Mr. Greene.

Results obtained during season of 1872 *by steam canal boats competing for State award.*

STEAMER.	Number single trips made through canal.	Average speed over ground, exclusive of detentions, miles per hour.	Average horse-power generated.	Pounds coal consumed per boat per mile.	Slip of screw, per cent.
A. H. H. Dawson	6	*2.1	*39	62.6	60.7
William Newman	6	2.73	*32	65.2	42
William Baxter	6	3.06	28	31.0	23.5
Chas. Hemje	5	3.15	40	60.9	57
Fountain City	4	2.75	43	89.6	†
Port Byron	6	2.68	45	64.4	67

The report for 1872 of the commissioners stated that the time had not been sufficient to properly complete the necessary tests, and recommended a continuance of the reward offered under the law of 1871.

The Legislature, on May 9, 1873, passed a law continuing the powers of the commission for one year further.

Season of 1873.

Under this act investigations were continued during the season of 1873, and the following five new steamboats were brought to the attention of the commission:

1. The "C. C. Pope" was an ordinary full-sized lake boat, to which machinery had been applied. Her weight, light, was 75.7

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* Approximate only. † Not determined.

tons and she carried 202 tons cargo when drawing five feet eleven inches of water. The engine was single, with cylinder ten inches in diameter and twelve inches stroke. The boiler was eleven feet long and four feet in diameter. The screw was four-bladed, six feet in diameter, with six feet pitch. The peculiar feature of this boat was the adjustability of screw and rudder, by which complete immersion was obtained at any draught of vessel. She was also supplied with a small steam winch, which was employed in assisting her through locks. The adjustable device, however, appears to have been unsatisfactory in action and to have given out shortly after trial.

2. The "C. C. Smith" was of a type similar to the Fountain City, and was apparently a failure.

3. The "Peter Cooper" was similar to the Port Byron and Montana, but she was not tested, nor did she appear to have accomplished anything in the way of improvement.

4. The "A. E. Webster" was similar to the Dawson, but was propelled by a compound rotary engine. She did not compete in the official trial, but it appears that experience showed that she would run much better stern foremost, and she was accordingly run in that manner during the season.

5. The "City of New York" was the second boat built by Mr. Baxter on the plan of the William Baxter. She was somewhat larger, and her engine was built on a different plan, with two high pressure cylinders and one low pressure cylinder cast together, four and three-quarter inches and fourteen inches in diameter and fourteen inches stroke. The boiler was vertical, seven feet high and forty-eight and three-quarter inches in diameter. She was propelled by a single four-bladed screw. The accompanying plate III illustrates the modified type.

For a final determination of the merits of the competing steamers, the commission announced a public trial to be held October 15 and 16, 1873, between Syracuse and Utica, and the results attained by the five steamers entering, are incorporated into the following table:

SUMMARY of Results of Trial of Canal Steamers between Syracuse and Utica, on the 15*th and* 16*th of October,* 1873, *under the direction of the Commission appointed under act chapter* 868, *Laws of* 1871.

Number.	NAME OF STEAMER.	TIMES.				SPEEDS.				COAL CONSUMPTION.		PROPELLING INSTRUMENT.	
		Total from Syracuse to Utica.	Detentions in locks and at Rome.	Other detentions.	Running time.	Syracuse to Utica, miles per hour.	Syracuse to Rome, miles per hour.	Rome to Utica, miles per hour.	In still water, miles per hour.	Total, lbs.	Per mile, lbs.	Speed of. miles per hour.	Apparent slip, per cent.
		H. M.	H. M.	H M.	H. M.								
1...	William Baxter	20 09	0 53.4	1 09	18 06.6	3.09	2.92	3.53	3.40	830	14.82	4.55	33.1
2...	William Newman	27 08	1 31.4	3 57	21 39.6	2.59	2.41	3.48	2.89	4,000	71.5	7.68	66.3
3...	C. C. Pope	26 35	3 44.4	0 25	22 25.6	2.50	2.20	3.29	2.77	2,520	45	5.17	51.6
4...	Port Byron	29 ..	3 25.4	3 01	22 33.6	2.49	2.29	3.25	2.77	5,425	96.9	7.59	67.2
5...	Central City	27 52	2 59.4	2 43⅛	22 09.1	2.53	2.29	3.52	2.77	7,080	126.48	5.72	54

NOTE.—The speeds in still water. are determined by adding to the speeds between Syracuse and Rome (against the current) one-half the average difference between the speeds east and west of Rome.

The commission concluded its final report as follows:

After a further examination of the record of the competing boats, and of the conditions and requirements of the law, it was finally determined by a majority of the commission that no award or certificate be made to any competitor.

The commission then adopted the following resolutions by the unanimous vote of all the members present:

Resolved, That in the opinion of this commission, after all the tests and trials made, the inventions, devices and arrangement of machinery of the boat William Baxter are the best adapted to fulfill the objects sought to be secured by the law.

Resolved, That the inventions, devices and arrangement of the machinery of the boat William Newman have given highly satisfactory results, and possess, in the judgment of this commission, very great merit.

Resolved, That doubts have arisen as to the meaning of some of the provisions of the law under which this commission is acting, and differences of opinion existing among its members as to its powers and duties, growing out of the complex and stringent conditions to be fulfilled by competitors, it is believed that the object of the law will be better attained by the Legislature dealing directly with the subject than by continuing the powers of this commission beyond the time now limited by law.

Resolved, That this commission respectfully recommends that the Legislature shall enact a law that shall do justice to those competitors who have so nearly met the requirements of the law of 1871, in spite of the stringency of its provisions, and have spent much time and money in the introduction of steam for the propulsion of canal-boats, and have, by their boats in actual use, shown the value to the State of their improvements; and to that end the commission, following the general drift and intention of the law, respectfully submits the draft of a law, that in its opinion will be just and equitable to certain competitors therein named and will best fulfill the honorable obligations assumed by the State in its efforts to foster and develop its internal commerce by inviting and rewarding the introduction of steam or any motor other than animal power for the propulsion of boats upon the canals:

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Resolved, That the foregoing report and resolutions, together with the report of the engineer, be transmitted to the Legislature by the chairman of this commission.

Dated ALBANY, *February* 19, 1874.

Respectfully submitted.

VAN R. RICHMOND,
GEORGE GEDDES,
DAVID DOWS.
WILLIS S. NELSON,
GEORGE W. CHAPMAN,
WILLIAM W. WRIGHT,
JOHN D. FAY,
DANIEL CROUSE,
Commissioners appointed by chapter 868, *Laws of* 1871.

Season of 1874.

Operations during the season of 1874 are described by State Engineer and Surveyor, Sylvanus H. Sweet, in his annual report for the year 1874, Assembly document No. 80, 1875.

In accordance with the recommendation of the commission, so far as the steamers City of New York and William Newman were concerned, the Legislature passed the following act:

Chapter 618.

AN ACT for the relief of William Baxter, David P. Dobbins and Theodore Davis.

PASSED June 8, 1874, by a two-third vote.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. The comptroller shall pay William Baxter, or his legal representatives, upon the presentation of the certificate of the state engineer and surveyor that said William Baxter has placed, during the season of navigation of eighteen hundred and seventy-four, upon the canals of this state, seven steamboats fully equipped, and being in all respects equal in power and capacity to the steam canal boat "City of New York," to fulfill the requirements and conditions of chapter eight hundred and sixty-eight of the laws of eighteen hundred and seventy-one, the sum of thirty-five thousand dollars; and the comptroller shall in like manner, upon the certificate of the state engineer and surveyor, pay to David P. Dobbins, or his legal representatives, whenever he shall, within the season of navigation of eighteen hundred and seventy-four, have placed upon the canals of this state three steamboats, each fully equipped, and being in all respects fully equal in power and capacity to fulfill the requirements and conditions of chapter eight hundred and sixty-eight of the laws of eighteen hundred and seventy-one, to the steam canal-boat "William Newman," the sum of fifteen thousand dollars. And the comptroller shall in like manner, upon the certificate of the state engineer and surveyor, pay to Theodore Davis, or his legal representatives, whenever he shall, within the season of navigation of eighteen hundred and seventy-four, have placed upon the canals of the state, one steamboat, fully equipped, and being in all respects fully equal in power and capacity to fulfill the requirements and conditions of chapter eight hundred and sixty-eight of the laws of eighteen hundred and seventy-one, to the steam canal boat "Central City," the sum of five thousand dollars.

§ 2. This act shall take effect immediately.

Pursuant to the terms of the above act, William Baxter placed upon the State canals the following seven steamers: William Baxter, City of New York, City of Buffalo, City of Albany, City of Syracuse, City of Troy, City of Rochester.

David P. Dobbins, or his legal representatives, placed upon the canals the following three steamers: William Newman, City of Utica, Ilion; and Theodore D. Davis placed upon the canals the steamer Central City.

State Engineer and Surveyor Sylvanus H. Sweet granted the required certificates, thus terminating the competition and awards.

From the State Engineer's report it appears that the steamers placed upon the canal by William Baxter and by David P. Dobbins, including also an additional steamer, the City of Newark, were subsequently owned by the "Baxter Steam Canal Boat Transportation Company," by whom the boats were put in operation and run as fast as they were completed.

These steamers, in 1874, required, on an average, fifteen days for a round trip between New York and Buffalo, and consumed bout twelve tons of coal per round trip. The incidental expenses a round trip were shown to be as follows: Crew and board,

$112.50; engineer's wages, forty dollars; coal, twelve tons, at six dollars, seventy-two dollars; oil and waste, say six dollars; total, $230.50.

Of these boats, two made eight round trips, one made five, four made four, and two made one each.

The following is from the State Engineer's report:

The following statement of the expenses for the season of 1874, for an average of four boats for the whole season, is furnished by the Baxter company:

1.	Pay of captains, crews and engineers	$6,073 15
2.	Extra labor	780 00
3.	Coal	2,200 00
4.	Oil and waste	455 14
5.	Tolls	8,394 27
6.	Commissions	1,140 56
7.	Insurance	1,265 80
8.	Elevating	1,481 70
9.	Stationery	509 44
10.	Profit and loss	621 91
	Total	$22,921 97
	Add for depreciation and interest	7,040 00
		$29,961 97

Since 1874 the records of progress made in steam navigation upon the canals are disjected.

In 1877 State Engineer John D. Van Buren Jr., in his annual report for that year (Ass. Doc. No. 9, 1878) discussed the question of canal transportation.

In the following year State Engineer Horatio Seymour, Jr., discussed the same question at great length and recommended increasing the depth of water in the canal one foot and the application of water power machinery at each lock to aid the speedy passage of boats through the locks.

The estimated cost of increasing the depth of water one foot by raising the banks was less than $1,100,000, and of applying machinery to a double lock, on the plan devised by then Division Engineer Elnathan Sweet was $3,200.

In this report were also incorporated statements of the actual cost of running horse-boats during the season of 1877, by Messrs. Niles Case, Frank Beadle and John Pease; "representing some of the most reliable lines of horse-boats;" of the actual cost of running the Baxter steamer "City of Rochester" and consort for the season of 1878, by Capt. Spurr, master, and the estimate by Mr. Alonzo Richmond of the cost of transportation by the latter system based on the "cost and carrying capacity of two boats such as could be built at the present time."

The results of these statements and estimate are incorporated into the following table:

Cost of transportation, Buffalo to New York by Erie canal, 1877–78, *exclusive of tolls.*

ITEMS.	ACTUAL EXPENSES OF HORSE BOATS.			STEAMER AND CONSORT.	
	Niles Case.	Frank Beadle.	John Pease.	Estimate of Alonzo Richmond.	Expenses by Capt. Spurr.
	Cents.	Cents.	Cents.	Cents.	Cents.
Cost per ton mile	0.235	0.259	0.288	0.202	0.201
Cost per bushel of wheat, 495 miles	3.48	3.85	4.27	3.00	2.98
Elevator charges, New York.	0.50	0.50	0.50	0.50	0.50
Trimming, New York	0.11	0.11	0.11	0.11	0.11
Cost per bushel moved 495 miles and transshipped at New York	4.09	4.46	4.88	3.61	3.59

The foregoing statements and estimates are based upon return cargoes for horse-boats of fifty-seven and one-half tons and for steamer and consort of 100 and 125 tons respectively, in estimate, while the actual cargoes carried east by the "City of Rochester" and consort averaged 414 tons and those carried west averaged 225 tons.

Erie Canal Transportation in 1891.

On October 27, 1891, I received your instructions to investigate the modes of transportation prevailing upon the State canals, and, so far as possible, in the limited time then remaining before the close of navigation, I have endeavored to familiarize myself with the methods employed, the obstacles encountered and the steps which might be taken to improve the one and remove the other. In the work of observation and recording data, I have been assisted by Mr. Carleton Greene, C. E., of this department, working together where two were essential, and separately when possible, in order that the fullest data might be obtained.

The work in the field consisted in accompanying steam fleets along such portions of their trips as seemed advisable, obtaining whatever general information the captain or crew might afford, and observing, meanwhile, the time absorbed in delays and in locking, the amount of coal consumed, and, at fifteen-minute intervals, the steam pressure and vacuum carried, the number of revolutions and the nominal point of cut-off.

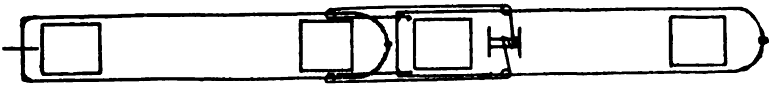
We were received by all boatmen with the utmost courtesy, and entertained to the extent of their ability for as long a time as we desired, while every facility was offered for the prosecution of our work. The greatest difficulty encountered was the location of any fleet along the canal. In many cases the only information to be obtained was the day of clearing from Buffalo or West Troy, from which meager starting point it was necessary to deduce the railroad station nearest the boat from two to five days later. Through the courtesy of Hon. John Lighton we were enabled to establish a sort of bureau of information at Syracuse, but it was found from experience that the surest way was to remain upon one steamer until another was met, boarding her, if in day-time, or overtaking her next morning by rail, if met at night. In this way we were enabled to make trips of from five hours' to two days' duration on sixteen different fleets, and to visit three others on the canal. Subsequently Mr. Greene visited ten other steamers lying in docks near New York city, and obtained such general information as was possible.

The table which you publish with your report shows the dimensions, character, manufacturers, etc., of each of these boats, its boilers and engine, and while it is to be regretted that the list is not larger, the boats included therein may be taken as fairly representing the various gradations in the steam fleet at present navigating the Erie canal and Hudson river.

The methods of transportation in vogue on the canal to-day are three: By horse-boats, steam canal boats and consorts, and steam packets. The through traffic is carried on in the first two; way traffic, in the first and last.

Of the steam packets, so called, there is little to be said. They run as freight lines between various places on the canals, occasionally carrying passengers where the railroad is not available and time no object. They range in size from that of a steam launch to nearly the overall dimensions of a canal boat, although the lines of the hulls are finer than those of a canaler. Interest in them is chiefly confined to their tendency to run at a rate of speed so high that a wave is cast upon the towpath, giving rise to an injurious wash of the banks. A boat of this character, only forty or fifty feet long and drawing about three feet of water, when driven at a speed of six or seven miles an hour, will cause more damage in this way in a single week, than the whole fleet of steam canalers would in a season's steady running.

The horse-boats on the canal have adopted, almost without exception, the "double-header" plan, being the one attributed to Mr. William Frick, of Chester, Penn., with slight modifications. The Frick steamers were steered by deflecting the rudder of the rear one and by changing the angle between the boats simultaneously, through the same gearing. The accompanying sketch will illustrate the present plan, which, it will be observed, does away with any adjustment of the rudder, which is left to swing free, save when the boat is running light in a strong wind; when it may become necessary to man the after tiller.



The rear boat is thus used as a rudder for the forward one, and the flexibility of this pair is remarkable, but may be appreciated by considering that, whereas, a single boat may have a rudder five feet long, these have one over ninety feet in length The lengthening of one tier of locks and the application of machinery to the work of hauling boats in and out, has so facilitated locking that one of these double-headers will now lock in a shorter time than was formerly required by a single boat. The single boat is no longer employed in the through trade, while a number of "triple-headers" are now seen; that is, three boats joined similarly to the double-headers.

The economy of this system is manifest, now that the delay in locking has been removed. Whereas, the single boat running day and night requires a crew of four men and four horses or mules, the double-header may be manned by the same crew and requires but two more horses, three to a team.

Horse-boat Transportation on Erie Canal, 1891.

Generally speaking, the methods employed by horse-boatmen are similar to those followed by the steam canalers and hereafter described.

The great bulk of Erie canal traffic is carried on in "double-headers," consisting of two horse-boats of 230 to 250 tons capacity each, coupled together as described.

The present tendency is to build boats of 250 tons capacity, the largest that can be passed through the present locks. These "double-header" fleets, if they may so be called, are towed by teams of three mules or horses in a shift, each team working twelve hours per day. To man these boats requires a crew of two steersmen and two deckhands or drivers, besides the captain, working in six-hour shifts, although some boats dispense with one of the steersmen.

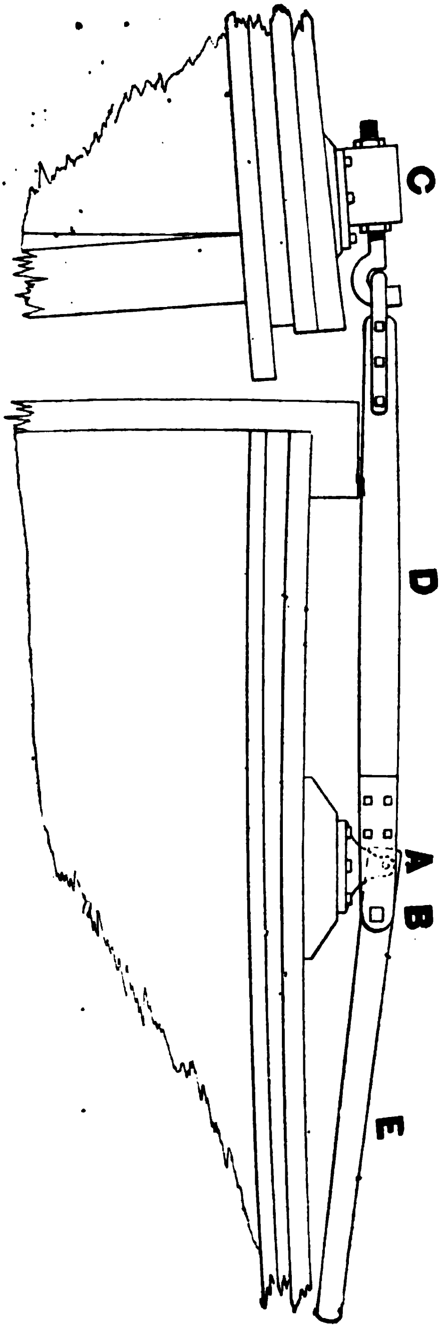
The trip through the canal is made in a manner similar to that of steam fleets; but the horse-boat goes much slower, a double-header requiring nine or ten days for the run from Buffalo to West Troy or Albany, or at least two days longer time than a good four-boat steam fleet.

At Albany the boats are made up into fleets of greater or less size, towed to New York, and distributed in the manner hereafter described under the head of Hudson river barge transportation.

The river trip consumes about three days each way, making the average running time per round trip about twenty-five days, inclusive of ordinary delays en route. Thus a pair of these boats has but five days' margin to spend in port at Buffalo and New York to complete a round trip in one month. In a season of seven months' navigation, therefore, with no extraordinary delays in port or in transit, seven trips can be made, but it is apparent that a shortening of the season in any way, or unusual delays caused by breaks or by a diminution of water supply in the canal, or by damage to the boats or structures along the canal, or by failure for any reason to load and discharge cargo promptly may, and in fact have, decreased the probable number of trips per season to six. These facts will show clearly how important it is to the prosperity of the boating business to minimize each delay, when the possible causes of detention are so many. A break of one day's duration might hold many boats at one end or the other of this 500-mile stretch, through the winter, and so deprive them of the benefit of one more trip. The boats winter generally at Buffalo or New York; some few along the canal. The insurance companies will not accept risks after a certain date each year, and a boatman desiring to winter at the other end may be compelled, through lack of time, to make the last run light in order to escape ice. The estimates given hereafter will demonstrate how serious the consequences of such delays may be.

As stated above, the present tendency is to build boats carrying 250 tons, although a 240-ton boat is still the usual size. All boats take full cargoes east, but return loads, when taken, will rarely exceed 100 tons per boat, which is the usual cargo to-day. The boat, however, cannot afford to lose any time looking up a return cargo, but if rates from Buffalo east are good, will run back light as soon as the cargo is discharged, and thus it happens that the proportion of through freight carried west is less than the above mentioned average return cargo would imply.

The locks have so been lengthened that the single locks are concentrated into bunches in five places, viz.: Lockport, Newark, Little Falls, Rexford Flats and between Cohoes and West Troy, and the delay due to uncoupling thus nearly minimized. As a matter of fact, boats sometimes uncouple and take the single lock


C
D
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E

when another double-header is met or overtaken in the lengthened lock, but this is essential only at the above-mentioned places.

Steam Canal Boat Transportation, 1891.

The methods employed by steam canal boats are various, depending upon the fancy of the captain of the fleet or upon the number of boats which he is able, or has found it desirable, to propel. They are as follows:

1. Steamer pushing one consort.
2. Steamer pushing one consort and towing one.
3. Steamer towing a double-header.
4. Steamer pushing a consort and towing a double-header.
5. Steamer towing a double-header and a single boat behind the double one.
6. Steamer pushing a consort and towing a double-header and a single boat behind the double one.
7. Steamer pushing a consort and towing two double-headers.

The accompanying sketch shows the typical coupling employed in connecting steamers and consorts:

The coupling is double, and, consists, on each side of the boats, of a connecting arm, D, hooked on a vertical axis to a spring buffer, C, and engaging the lever, E, by a pin on a horizontal axis at B; the lever E, being pivoted on a horizontal axis to a lug into the gunwale at A. The arm of the lever, E, above the pin, is of wood set into a cast-iron socket, so as to unship like a capstan bar. The arm, D, being adjusted to a proper length, and the lever, E, thrown forward, the arm is hooked to the buffer and the lever drawn back, bringing a strain upon the powerful spring in the buffer, and drawing the boats together with great force. The instant the lever, E, passes below the horizontal, aft, the strain on the arm tends to lower it still further, thus locking the apparatus. The stern post of the consort is held in the center line of the steamer by two lines attached to the consort at the stern and passing through the fairleaders of the steamer to the windlass where they are drawn taut and secured. The two boats thus become as one and answer to the rudder of the steamer with surprising promptitude. This is called by the boatmen the "Illinois canal" system, but is a very great improvement upon the original which is still in vogue upon the Illinois and Michigan canal, as described hereafter in this report.

The double-header tows are made up like horse-boats and are towed with hawsers five inches in circumference and from 300 to 500 feet long, the average probably being somewhat less than 400 feet.

Of the seven types of fleets mentioned, the fourth is what may be termed the present standard arrangement and will be the one referred to hereafter, unless otherwise stated.

The steamer having made up her fleet in Buffalo, in this fashion, steams uninterruptedly a distance of thirty-two miles to the head of the five combined locks at Lockport, where the fleet is broken up and lowered through the single locks separately and reassembled at the foot. From this point to the Newark locks, 97.42 miles, the fleet may remain coupled. The operation of locking through a lengthened lock is simple, the steamer and consort entering first and, as they pass out, the hawser is slacked from the tow, until the steamer is free of the gate. The lock is then shifted, the tow is pulled into the lock by the steamer and, as soon as the tow is ready, a start is made, and the hawser readjusted at the proper length. On well-managed fleets, the captain of the tow is provided with a horn and a code of signals arranged for starting, stopping, slackening or taking in hawser, and by this means the locking proceeds without an instant's delay in shouting orders back and forth. The Newark locks, Nos. 57, 58 and 59, are separated by levels of 840 and 720 feet respectively. At this point, the fleet is uncoupled, the steamer propelling herself through the locks and surrendering her consort and tow to horse-teams which are kept for this purpose. A charge of fifty cents per boat is made for towing from upper to lower level, which expense is borne by the steamer when towing-boats not belonging to the same owner.

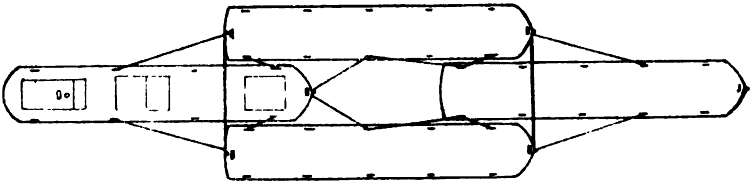
At Little Falls, the next break in the chain of lengthened locks, 136.38 miles from Newark, a similar operation takes place, the charge being seventy-five cents per boat, for towing through the four locks, Nos. 36, 37, 38 and 39, separated by levels of 3,160, 740 and 1,035 feet respectively.

At Rexford Flats, 56.93 miles from Little Falls, there are two unlengthened locks, Nos. 21 and 22, 915 feet apart, through which boats are towed for thirty-three and one-third cents apiece.

Lock 23, being the last lengthened lock, the fleet must be uncoupled at each one from here to the river. Between locks 21 and 20 there is a stretch of 3.22 miles; between 20 and 19, 2.74 miles, and between 19 and 18, the uppermost lock at Cohoes, 8.86 miles.

When approaching Cohoes, the captain of the steamer sends word to West Troy, and is met at the head of the sixteen locks by drivers and horses for his consort and tow. These locks, Nos. 3 to 18 inclusive, are separated by levels varying from 590 to 1,640 feet in length, the lower one, No. 3, being about five-eighths of a mile from the upper side-cut at West Troy, through which access is usually had to the Hudson river. The lower side-cut is one mile and a quarter further. The steam fleets rarely traverse the canal between Albany and West Troy, preferring the open navigation of the river. For towing the consort and tow between the head of the sixteen locks and the river, a distance of about four miles, a charge is made by the proprietors of these teams of three dollars per descending boat and four dollars per ascending boat.

Having reached the river, the fleet is made up as shown in accompanying sketch, five and six-inch hawsers being employed and everything fastened with the utmost care.



Sometimes a tug is employed to assist between West Troy and Albany, but below the latter point the steamer handles her fleet as a single boat, propelled and steered like any craft 215 feet long and fifty-three feet wide. Notwithstanding the unfavorable location of the pilot-house, well aft on the steamer, these fleets handle with apparent ease.

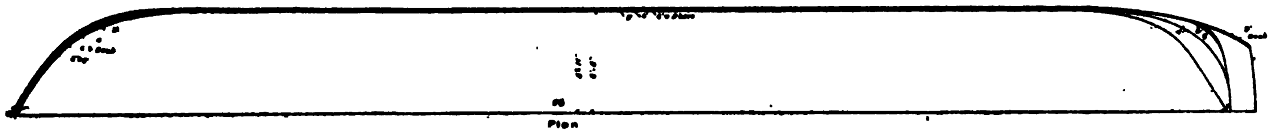
Upon reaching New York, the steamer either distributes her fleet as directed by the consignee or surrenders the boats to tugs for proper disposal; but it is at the termini, in New York and Buffalo that the advantage of a steamer is most apparent. The freight paid involves merely a delivery of the boats, steamer included at the general landing place. The fleet must, of course, be distributed and returned when unloaded; and then when a cargo is obtained, it must be transferred to the storehouse and returned again. This makes four separate towages for which a charge is made of four dollars for each loaded boat, and three dollars for each light boat, within the limits of Twenty-third street, East river, and Twenty-sixth street, North river, in New York. Beyond these limits the charge is greater. In Buffalo, the rate is two dollars each boat each way. If the towing is done by tugs, the freight pays the tugs; while if the canaler does her own towing, the freight pays the charges to her. Thus a four-boat fleet may earn eighty-eight dollars a trip more than four horse-boats, other things being equal, while with a six-boat fleet this may become $132.

The Evolution of the Steam Canal Boat on the Erie Canal.

As has been stated, the early experimental steamboats were generally horse-boats altered in accordance with the peculiar views of each inventor. The Baxter boats formed a notable exception. Plate III shows the form and general arrangement of boats built by Mr. Baxter subsequently to the William Baxter.

Plates IV, V and VI, prepared by Division Engineer H. T. Beach, show the various stages of development since the construction of the Baxter boats. The Planet Line boats, Plate IV, were of the type known as "dish-pan" boats, from the peculiar form of screw employed. The hub of the dish-pan screw consists of a circular disk four feet in diameter, with a flange on one side of the circumference, to which the blades, usually about two feet long and four in number, are bolted. The diametric section of this cast-iron hub, being similar to that of ordinary channel iron, the hub bore a rude resemblance to a large dish-pan. As mentioned, the blades are two feet long, thus making the whole wheel eight feet in diameter, with a dead center four feet in diameter. The

Plate IV.



Plan

Model of the "Planet Line" Steam Canal Boats.
Built by B. F. Taber, Ithaca, N.Y.
1889.

Elevation

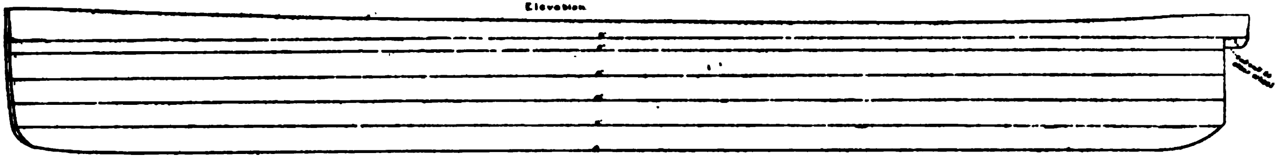
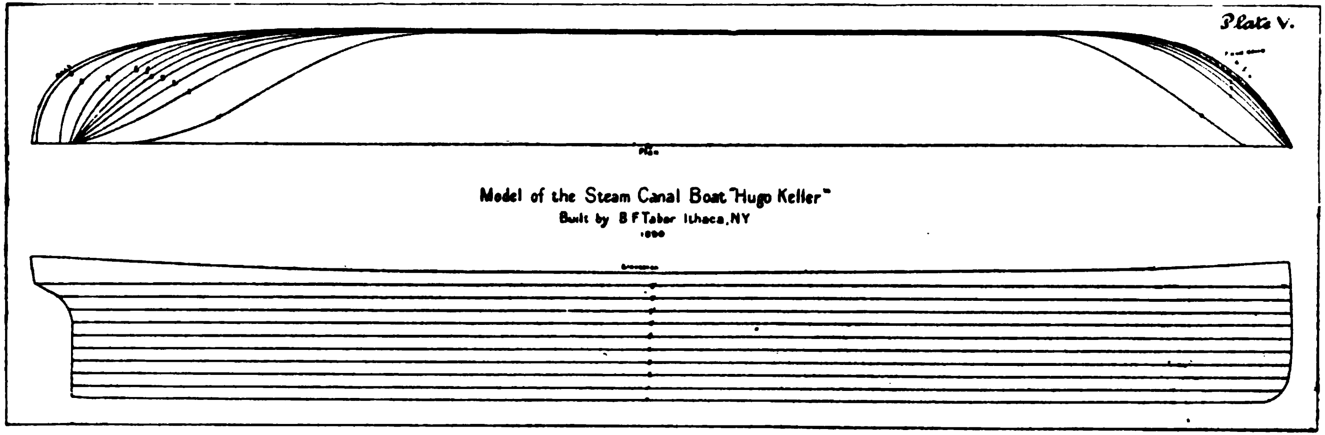


Plate V.



Model of the Steam Canal Boat "Hugo Keller"
Built by B F Taber Ithaca, NY
1890

object of this arrangement was to gain admission of water to the wheel without cutting away so much of the stern, which, with these wheels, may be blunt and four feet wide instead of diminishing to a stern-post. Apart from increasing the carrying power of the boat somewhat, this plan is open to serious objections.

The screw being eight feet in diameter while the mean draft of the boat ranges between one foot and six feet, the screw must always protrude at least two feet above water, thus losing ten out of 37.7 square feet available propelling surface, or about 26.5 per cent.

The model of to-day is shown by Plates V and VI, from which it is seen that much finer lines have been adopted at bow and stern. While the boats vary somewhat in length of run, in dimensions, in the disposition of cabins, in height of floors, in power of engines and in pitch of screws, Plate VI may be taken as representing, in model, dimensions and general arrangement, the standard steam canal boat on the Erie canal to-day.

Hulls.— The construction of these boats is practically the same, except as to models, as the best class of horse-boats. They are built both with pine and with oak sides. The pine-side boats have the oak frames at bow and stern, but the midship portion is made of five-inch pine bolted with long vertical bolts to clamp the whole side together. The oak frame boats have three-inch or four-inch ribs spaced about fifteen inches on centers and planked with two-inch oak in long planks.

Cabins.— The general disposition is shown on Plate VI. The forward cabin is occupied by the master and family, and is ingeniously arranged by a system of sliding doors for division into three compartments. The stove may also be shut off from the rest of the room. The middle cabin contains bunks for the crew. The upper portion of the pilot house is in sections for removal when traveling light in the canal. The usual location is over the boiler room, heat thus being afforded on inclement days.

Engines.— The arrangement of engine, boiler and appurtenances, shown on this plate and the succeeding one, plate VII, has been the type for years and is still adhered to. With some few exceptions the boats in present service are propelled by one of three types, or rather, manufactures, of engine. The greater number carry what are known as the Hall engines; but a number have been supplied with motive power by the Pound Manufacturing Company. These, plates VII and VIII, are simple, condensing engines, carrying cylinders of twelve or fourteen inches diameter and sixteen inches stroke, supplied with adjustable cut-off gear, feed-water heaters and surface condensers. The feed and air-pumps are worked by a single beam, usually connected, by eccentric, to the shaft, but sometimes to the crosshead. The circulation is obtained by the combined action of the motion of the boat and that of the screw, forcing the water through the passage, condenser and pipe as shown, plate VII. This method is very successful, yielding a vacuum of twenty-four inches by gauge, when properly constructed and kept clean.

Plate IX illustrates the steeple compound engine, applied to canal boats by Henry G. Trout. The high-pressure cylinder is ten inches in diameter; the low-pressure, eighteen inches in diameter and the common stroke is fourteen inches. The valves are rotary and three in number, the travel of the upper one being adjustable by the sliding bar called the sword-arm, for the purpose of varying the cut-off. The feed-water heater, condenser and pumps are similar to those of the Hall and Pound engines.

Boilers.— Two types of boilers are employed, according to the fancy of the owner. The horizontal boilers, as shown on Plates VI and VII, are about eight feet long and sixty-eight inches in diameter and are furnished with two and one-half-inch direct and three-inch return tubes. The vertical boilers are of a type peculiarly adapted to these boats. As shown by Plate X, they are furnished with a cylindrical magazine for coal, which is fed from the roof of the boiler room. The grates have a shaking arrangement, and many of these boilers have no fire door.

The brief experience of the present investigation has demonstrated that this is a serious error in construction, for while many of the steamers thus arranged report no trouble in managing the fires without a fire door, it is a fact that the fires will clinker and the grates will clog occasionally and then the only relief lies in burning the magazine of coal out and breaking the clinkers from above or else in drawing the fire entirely and start-

Plate X.

State of New York

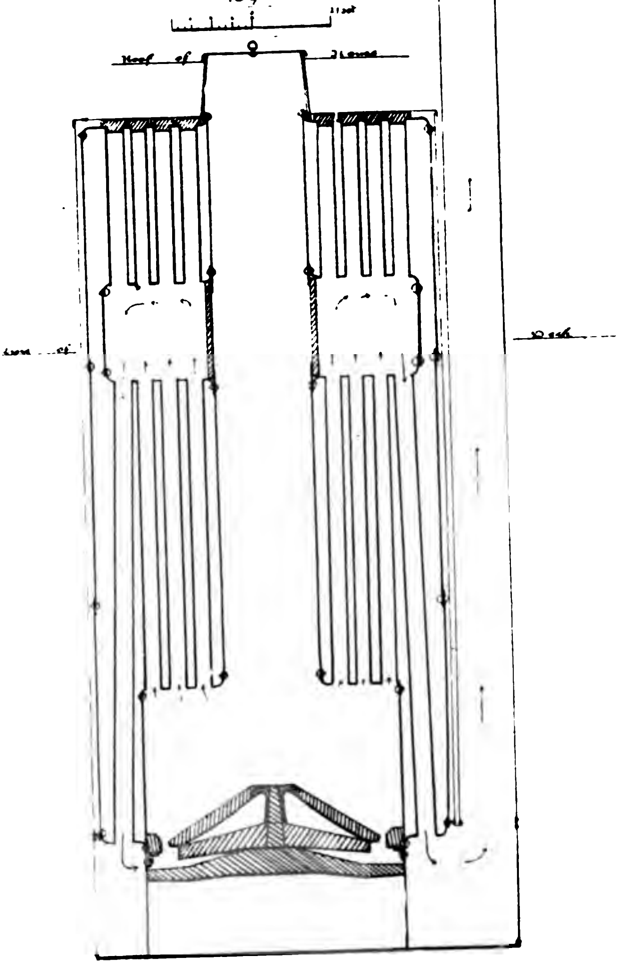
Department of State Engineer and Surveyor.

Vertical Magazine Boiler,

with Shaking Grate, – as applied to Steam Canal Boats.

by G. W. Hall, Lockport, N.Y.

–1891–



To accompany Report upon Navigation on the New York State Canals.

Transmitted 21st December '91.

John Bogart, State Engineer & Surveyor.

Aug. S. Kibbe, Assistant Engineer in Charge.

ing afresh. With a fire door this predicament cannot arise and a man who cannot be trusted to keep his fire door closed is not a proper person to manage even the poorest engine. These boilers vary from nine and one-half to eleven and one-half feet in height and from fifty-four to sixty-six inches in diameter and are furnished with between eighty and one hundred two and one-half-inch direct pipes and from thirty to thirty-five return tubes three inches in diameter. With these magazine boilers a small blower is always employed. This is usually a Sturtevant, twelve or fifteen inches in diameter and belted to run at about 3,600 revolutions per minute. The funnels of all boats are hinged at the roof of the boiler-room and counter weighted for tilting when running light, and a number of boats are provided with extra lengths of six or eight feet which are rigged upon the regular funnel when navigating the river or other bodies of water with higher bridges than those on the canal.

The coal burned on these steamers is almost entirely anthracite, purchased in five and six ton lots along the canal. One steamer, the George W. Dimmers, burns soft coal entirely and one, the John B. Dallas, takes on soft coal in New York and uses what she can carry, after which hard coal is burned until the boat again reaches New York.

In several cases there are built into the boat iron water tanks holding from 500 to 800 gallons, but the greater number of steamers carry two large cocoanut oil casks, when on the river, usually storing them at lock No. 3 while on the canal. In these tanks or casks is stored fresh water for the boiler below Newburgh, where the waters of the river first become brackish.

Screws.— The screws employed, with the exceptions of the "dishpans" above referred to, are about six feet in diameter, with a pitch varying from six to seven and one-half feet.

Performances of Boats, 1891.

In pursuance of your instructions, I have endeavored to obtain such data as would afford a conception of the improvements made in the past fifteen years and of the average performance of the present boats.

A table has been prepared and published in your report, preceding this appendix, which shows the results of observations upon the running of boats, but the following facts should be borne in mind:

Columns 2-6, 12, 13, 15 and 19 give the results of actual observations. The remainder were computed or estimated as best might be. Limited time and facilities precluded the possibility of observing the actual currents encountered or of applying the indicator to the cylinders of the boats examined. In estimating the currents in the canal, I have been guided by the reports of former State Engineers, and in computing the indicated horse-power, it has been necessary to accept the statements of the builders or the engineers as to the reliability of gauges and the point at which steam is cut off in the cylinder. In the cases of the simple engines, the results are in sufficiently good agreement to show that the information was given in good faith. The estimates were necessarily based upon volumetric expansion computations and the fact that all the cylinders were carefully lagged would increase the accuracy of the result. In the cases, however, of the compound engines of the steamers Carrie Stewart and Walston, it has been extremely difficult to determine the action of the valves. The lengths of the eccentric rods are adjustable, and the valve gear is so delicate that a slight difference in certain dimensions will effect a great change in the action of the valve. Then, further, the shaft of the Carrie Stewart has since been discovered to be badly out of line. Careful measurements have been made of the machinery as set up but I can assert no great confidence in the results here presented. Besides this difficulty, the cylinders and pipes are not lagged and hence the pressure in the cylinder is bound to be much less than estimated. The very small consumption of coal per theoretical horse-power per hour shows that this power must have been over estimated and, in my opinion, the power estimated is at least fifteen per cent in excess of what would have been shown by an indicator, and perhaps much more.

The slip of screws is also uncertain, but the results seem reasonable when the peculiar circumstances of the case are considered. In a contracted waterway, with heavy tows, and a screw in some cases a foot and more out of water, an average of sixty-six per cent compares favorably with the results on Lake Champlain, where steamers with screws fully submerged, towing, perhaps, ten boats at about three miles per hour, develop a slip estimated at from seventy-five to eighty per cent.

The important criterion, however, of the coal per boat or ton per mile is fortunately a determined quantity, both from our observations and the statements of the various masters.

The table is printed with your report on a preceding page.

Summarizing, we may say that the four-boat steam fleets on the Erie canal to-day run at an average speed of two and one-half miles per hour through the water, making the trip through the canal, 352 miles, in about seven and one-quarter days, with a coal consumption of about twenty and five-tenths pounds per boat per mile through the water, and manned by a crew of ten men (including the captain of the steamer), six upon the steamer and consort and four upon the tow.

To illustrate the practical division of a season's work a statement of the trips made by the steamer Walston and three consorts was prepared and is printed with your report. It is as follows:

TRIPS OF STEAMER WALSTON AND FLEET, SEASON OF 1891.

NUMBER OF TRIPS.		LEFT		ARRIVED		DAYS ELAPSED.		
West.	East	New York.	Buffalo.	Buffalo	New York	In travel.	In New York.	In Buffalo.
1	....	May 7†	....	May 16	....	9	....	3
.....	1	....	May 19	....	May 27	8	8	....
2	....	June 4	....	June 13	....	9	....	8‡
.....	2	....	June 21	....	June 30	9	10	....
3	....	July 10	....	July 19	....	9	....	16‡
.....	3	....	August 4	....	August 13	9	6	....
4	....	August 19	....	August 29	....	10	....	3
.....	4	....	Sept. 1	....	Sept. 10	9	5	....
5	....	Sept. 15	....	Sept. 24	....	9	....	5
.....	5	....	Sept 29	....	October 9	10	6	....
6	....	October 15	....	October 24	....	9	....	4
.....	6	....	October 28	....	Nov. 6	9	5	....
7	....	Nov. 11	....	Nov. 20	....	9	....	....
.....	7	....	Nov.	....	Dec.	*	....	....
Totals for thirteen trips						118	40	39
Averages						9 1-13	6⅔	6½

* Not reported. Caught in canal by ice, and had to break a way from Little Falls to West Troy

† Reported as leaving West Troy on this date and detained extraordinarily on canal.

‡ Laid in Buffalo to avoid encountering crowd of boats at a break in canal.

This fleet thus made seven round trips between Buffalo and New York and, out of 197 days' navigation, 118 were spent in traveling and delays en route; forty in New York discharging and loading cargo; and thirty-nine in Buffalo, discharging and loading cargo and delaying on account of breaks in canal. Including everything, this shows an average per round trip of eighteen days, four hours' running and thirteen days, four hours in port, or thirty-one days, eight hours per round trip. It would appear from this record and the statements of those engaged in canal transportation that a round trip per month is about what may be accomplished by such a fleet under present practice, and during a season of navigation extending from the first of May to the first of December.

As illustrating another and important phase of steam canaling, the season's work of the steamer Carrie Stewart has been tabulated and has been printed with your report on a preceding page. In a period of less than 270 days, this steamer traveled over 7,300 miles and with the boats towed made a total boat mileage of about 32,500 for the fleet.

Cost of Transportation, Erie Canal, 1891.

Statements of the present cost of transportation over the Erie canal have been prepared and submitted not only for comparison with past results, but to illustrate the problems now confronting the boatmen and governing the future prosperity of the canal system. While these results are not presented as the actual experience of any particular craft or fleet, nor are they obtained from written records, for bookkeeping is rare on our canal, they are, nevertheless, believed to be even more valuable and trustworthy, because they are deduced from general averages of the expenses of many of the oldest and most experienced boatmen.

Estimates have been made in the case of horse-boats on a basis of 250-ton boats, manned as described and run under average expenses as derived from rates obtaining on the canals to-day. While different boats are managed differently, the mean cost does not vary greatly. Some double-headers carry steady crews paid by the month, others carry but one steady man, the others being what are called "trippers," i. e., steersmen or deckhands engaging for the trip through the canal only. Trippers are paid one dollar to one dollar and fifty cents per day and board, according to the supply and demand. Board costs about thirty cents per day per man, making the cost per man, during a round trip of twenty days in the canal, of twenty-five dollars to thirty-four dollars and fifty cents. Steady men receive twenty dollars to thirty-five dollars per month and board, costing therefore thirty dollars to forty-five dollars. It costs about seventy-five dollars per month to feed six head of stock and about ten dollars per month for shoes and medicine. The incidentals include kerosene, tow-lines, etc. Commissions amount to five per cent on the price of freight. The rates of insurance are shown for various classes on a subsequent page.

Wharfage in Buffalo is free, but in New York there is a charge of thirty cents for each light boat, and forty cents for each loaded or partially loaded boat, for each dock touched. The wharfage rates for wintering around New York city vary. They are about twelve dollars or fourteen dollars for light boats and about forty dollars or fifty dollars for loaded boats. The estimates have been made for first-class boats carrying full cargoes; for old boats, the insurance increases and the capacity decreases. In the estimates fifty dollars per month during navigation has been charged against the captain for his time and board.

For the four-boat steam fleets, the estimates are made for steamers carrying 180 tons and for consorts carrying 250 tons each, full cargoes.

The steamers also sometimes employ "trippers," the average rates paid being for wheelsmen (one of whom is usually a river pilot), forty dollars and forty-five dollars per month and board; for deckhands, twenty-five dollars per month and board; for engineers, twenty-five dollars and fifty dollars per month and board; for captains of tow, forty-five dollars per month and quarters; for steersmen of tow, one dollar and fifty cents per day and board; for deckhands of tow, one dollar and fifty cents per day and board. Board costs about thirty cents per day, but the captain of the tow usually receives fifty cents per day for boarding his crew. The captain of the steamer is rated in the estimates at fifty dollars per month. The coal consumption per round trip for a four-boat fleet should not exceed thirty-six tons in a well-managed engine of the class employed, and there are several fleets now being run on this rate. Insurance rates on cargoes and hulls are given on a subsequent page.

Commissions are the same for all boats. The boats are estimated as first-class, though the same remarks would apply to these as to horse-boats. The return freights estimated are deduced from averages of cargoes and rates obtained by many steam fleets during the season of 1891, from which it appears that the steamers carried about 136 tons west; the consorts, 150 tons, and the double-header tow about 140 tons in each boat. The rates obtained varied from forty cents to one dollar and fifteen cents per ton, New York to Buffalo.

For the six-boat fleet, the information is more scanty. The estimate is derived from the experience of a fleet which ran during the season of 1891. Five round trips were made with boats of capacity and average return loads given with a coal consumption of fifty tons per round trip. The captain of fleet receives $315 per month for wages and board of himself and crew. The captains of the two double-header tows receive $140 per month each for same purpose making the cost to owner for wages and board the definite amount of $595 per month. The remaining items are estimated on the same basis as those for the four-boat fleets.

The cost of insuring 8,000 bushels of wheat, valued at one dollar per bushel is:

For a first-class boat	$20 00
For a second-class boat	25 00
For a third-class boat	30 00

which is invariably paid by the boat owner.

The following is the canal hull tariff, as issued in 1890 and still in force:

Steamers.

First class, one and one-half per cent, average	$150 00
Second class, two per cent, average	200 00
Third class, two and one-half per cent	225 00

Horse-boats and Boats that are Towed.

First class, one per cent, average	$75 00
Second class, one and one-fourth per cent, average	100 00
Third class, two per cent, average	125 00
Coal boats, two and one half per cent, average	125 00
Lumber boats, three per cent, average	125 00

For lighterage privilege, New York harbor, including.

Ice clause waived, first and second class, one per cent.

Ice clause waived, third class, one and one-half per cent.

For privilege to navigate Canadian waters, Lakes Erie and Ontario excepted, one-quarter per cent.

For privilege to navigate Long Island Sound, not east of Connecticut river, first and second class, one-half per cent.

For privilege to navigate Long Island sound, not east of Connecticut river, third class, three-fourths per cent.

Additional for each trip:

Boats not over three years old, also boats classing second, and not over four years old, may be written at first-class rate, average, $100.

Boats thoroughly well built, but intended for coarse freight only, not exceeding five years old, may be written at one and one-half per cent. Average, $125.

The tables printed with your report will serve to emphasize what has previously been said with reference to the importance of making as many trips as possible. The following are the average rates, by months, paid on wheat from Buffalo to New York during the season of 1891:

	Cents.
May	2.51
June	2.53
July	2.68
August	3.94
September	4.19
October	4.44
November	4.13
Average for season	3.49

Thus, the average rate for the season was about 3.5 cents. The tables, based upon actual receipts and expenditures and printed in your report, show that, at this rate, horse-boats making six trips suffered an average loss of over $500 per double-header. Some few made seven trips and so may, by strict economy, have managed to "come out even," although, if we deduct the loss given in the table, $198, from the interest and reserve charge per annum, $884, there remains an apparent profit of $686, and this fact will explain how it is that many boatmen have expressed satisfaction with the prevailing rates. It is too often the case that a man will run his boat or boats, simply repairing when he must, laying nothing by and replacing live stock with difficulty when any die, until finally his boat, having degenerated from first to last insurable class, meets with some accident, sinks, and is not worth the expense of recovery. The owner finds himself penniless and seeks employment elsewhere. Yet, while running, he "always paid expenses," and made "most as many trips as the others." There is nothing more certain than that the horse-boats, as a class, lost money during the past season, for five or six trips was the general average, and inasmuch as the through freight carried west was but 29.76 per cent of the through freight brought east, it is apparent that many must have returned light, the average return cargo being five-twelfths, or forty-two per cent, of the full cargo carried from Buffalo to New York.

It is safe to assert that unless some way is devised to enable the horse-boats to make at least seven round trips per season, or to raise the rates paid upon freight, they have seen their day, and the end is not ten years distant.

Increase of traffic can not aid them. They can not feed their stock upon that. Their horses and mules are already cruelly overworked, but one can better endure the death of a mule than starvation, and the boat must move as fast as it does, and should move faster. The items in the estimates of annual expenses of double-headers, directly chargeable to motive power, amount to nearly $1,000 or forty-two per cent of the total annual expenses of a six-trip boat, and in about the same proportion for a seven-trip boat, equivalent to $300 per round trip or thirty cents per mile.

In contrast to this expensive means of locomotion we find that for a four-boat steam fleet, making six trips, the expenses chargeable to motive power amount to a trifle less than $2,000, or twenty-four and a half per cent of total annual expenses; and for a fleet making seven trips, to $2,100, or twenty-five per cent of total annual expenses. Thus these four boats are taken through the canal in two days less time than a double-header horse-boat requires, at an expense only $100 per year greater. The steam fleets therefore cost $1,800 per year less than it costs to take the same number of boats through the canals at the slower speed. No further details are necessary to establish the superiority of the steam fleet over the horse-boat.

In this connection it will be of interest to refer to sources of income apart from the regular canal business.

When the canal has closed, the horse-boat may either lie idle or may work as a lighter around the harbor of New York, at rates ranging between two dollars and three dollars per day, or may lie loaded, and so yield more or less as a storehouse.

The steam fleet may run south through the inland route and work in warmer waters or may run up the sound and so keep working the year around. It frequently happens that cargoes are obtained for places off the line of the canal at much better rates than are being paid thereon, while many steamers built for the canal engage in outside traffic altogether. While not directly connected with a consideration of the canal question, pure and simple, this means of employment not only opens a field for boats of this type but offers a means of tiding over a period of depression in rates or business which is not available to horse boats.

The query naturally arises, why, if the advantage of steam canaling is so manifest, more horse boatmen do not change their motive power, or why more steam canal boats are not built by outside parties. To the first the reply is that many do not see the advantage or are too conservative to change, but more are unable to command the necessary capital. Steam fleets should not consist of less than four boats, and counting a double-header already owned as two, there would be required an outlay of at least $11,000 for a steamer and consort, the only offset being the amount to be realized from the sale of the live-stock. In answer to the second query, it may be said that the profits are so variable and so dependent upon matters beyond the control of the boat owner, besides involving much labor and familiarity with canal business, that the field is not enticing to ordinary capital.

Obstacles to and Difficulties in Navigation upon the Erie Canal, and Remedies therefor.

These have their source either with the boats and their management or with the canal.

Independent of any consideration of radical enlargement of the waterway or structures, there are means by which the canal may be improved, both for the horse-boats and for steam fleets.

Bends in the canal.— There are many places in the canal where the bends are so abrupt that a tow-line 350 feet long will graze a bridge abutment while the steamer and its tow are both in the middle of the canal, yet invisible to one another. It is difficult enough to take one of these fleets around such a bend with the canal otherwise free, but when a double-header is met at such a point, the problem becomes complicated. Every foot removed from the inner bank on such a curve would prove a boon to the steam canaler.

Vertical walls at locks.— The steam fleet has created a necessity, which could hardly have been foreseen. When a steamer and consort have been locked down through a double lock, the after boats are towed partially or entirely into the lock. This must be done very slowly and with little steerage way. In the night, or with a high wind, it is impossible to keep the bow of the steamer's consort off the slope at the end of the vertical wall. In almost every instance which came under my observation, our boat grounded at these points, often involving considerable trouble and loss of time. The vertical walls below the lengthened locks should not be less than 400 feet long and 500 feet would be better.

Locks.— In the effort to increase their capacity the dimensions of boats have reached a maximum and the result is that when a loaded boat enters a lock, the water in the lock has to be forced through a very restricted channel. If the boat is descending, the water may be urged over the lower gates, or may be released through one of their valves; but, if ascending, the difficulty is very great for the gate leakage must also pass out until the lower gates are closed. If, besides, the lock is one of the first ones lengthened, the chamber of the new lock is of the same width as that of the old and the process of entering becomes very wearisome. The trouble on this score is serious only at locks lifting toward the east, viz.: At Port Byron, Jordan, and the three locks at Syracuse. Any alleviation would be welcome and of decided advantage.

The unlengthened locks.— In the accompanying statement of the time required for lockage, are given indications of the time required for passing the three large series of unlengthened locks, viz., at Lockport, Newark and Cohoes. There are also four unlengthened locks at Little Falls and four between Schenectady and Cohoes. Mention has also been made of the practice of breaking up steam fleets and passing the boats separately by means of animal power, through the Newark, Little Falls, Rexford Flats and Cohoes locks. Generally speaking, the boats towed by horses at these points, make the same time as the steamer. There would, therefore, be little gained were the locks lengthened in a manner similar to the others on the canal, for the steamer could not take four boats through a lock, capable of passing but two boats at a time, in any less time than she can pass alone through an unlengthened lock. At Lockport, the fleet passes the combined locks connected by hawsers, and in about twice the length of time required for the steamer. The steamer Acme was locked from lower to uppermost level in thirty-two minutes, and thirty-six and one-half minutes more elapsed before the last boat of the tow had ascended. The time lost here is very small when the elevation of fifty-six feet overcome is considered, and as the locks are not yet worked to anything like their maximum capacity, the necessity of change is not at present great. At Newark, the substitution of two combined locks and an improved alignment* as proposed, would do away with the splitting up of tows and would save much time. A four-boat fleet could probably be locked through the proposed locks with a total delay of less than thirty minutes, while one hour and fifteen minutes is not an unusual period for the three present locks. At Little Falls the intervals between locks are much longer, and, consequently, greater benefit would be derived from lengthening, but not so great as in the cases of locks 19 to 22, inclusive, where the greatest present need for lengthening would seem to exist.

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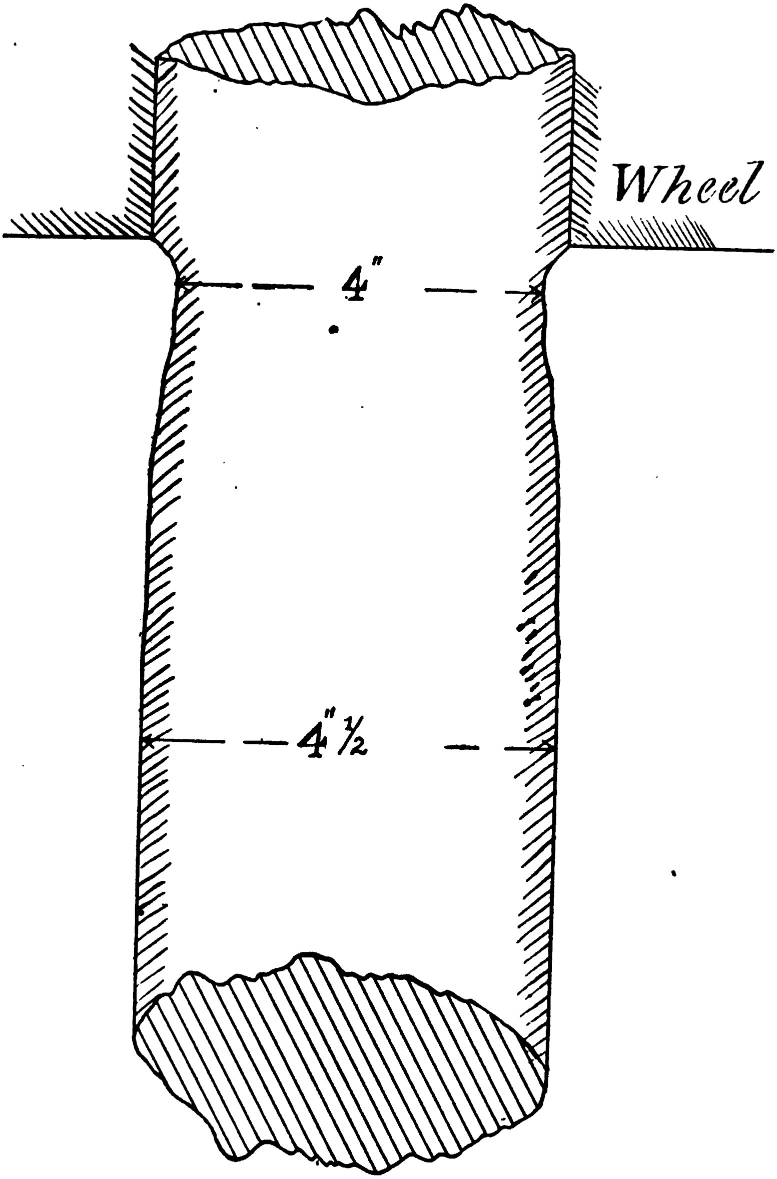
* See State Engineer's Report for 1890.

Splitting of tows in locks.—This difficulty is encountered only by steam fleets, but is a source of considerable delay and annoyance thereto. As heretofore described, the operation of locking a steam fleet of, say, four boats through a lengthened lock is performed with the fleet connected. Thus the steamer can always control her fleet. But it frequently occurs that, after the steamer and pushed consort are locked through, the hawser has to be dropped and the fleet left to drift about without motive power, until a double header, moving in the opposite direction, enters the lock and is passed through. This saves the locktenders the trouble of shifting the lock, but places the steam fleet in an awkward predicament. If the tow is lying above the lock, the gate valves are opened, and the current thus caused finally draws the boats into the lock; but a vastly larger amount of water is used than would have been required for shifting the lock without a boat, while the fleet is subjected to unnecessary annoyance and delay. If the fleet is ascending, and the tow is thus lying below the lock, the delay and attending trouble are still greater, as the effect of a current is then to carry the boats away from the lock, and they are sometimes brought up with great difficulty. The degree of this annoyance may best be appreciated when it is known that the captains of steam fleets will sometimes uncouple the whole fleet and lock it through the single lock, in order to avoid letting go the hawser. It is my belief that if this practice were abandoned, and steam fleets allowed to lock through the lengthened lock without interruption, after their turn had come, not only would they be saved much trouble and many delays, but water would be economized and a better feeling engendered throughout.

Hay wire and tow-lines picked up by screws.— In the navigation, by screw-propelled steamers, of a waterway whose depth is but one foot greater than the diameter of the screw, it is inevitable that many objects should be stirred about and occasionally caught in the wheel, but the chief difficulty in this respect is encountered through a habit which horse boatmen have formed of dropping into the canal bundles of the fine wire with which bales of hay are now altogether bound. The rule concerning the disposition of tow-lines of horse boats is also disregarded to a great extent. One of these boats will lie on the berme bank for a whole morning, leaving the tow-line stretched along the bottom of the canal and it is almost impossible for a steamer to pass over this line without picking it up. One of the photographs submitted herewith shows the screw of the steamer James W. Morse, as it appeared in dry-dock at West Troy. Yards and yards of hay wire and feet of tow-line were unwound from the screw at this time, the hay wire having even worked up between the shaft and the bearing. The result is shown in accompanying sketch, drawn from a template cut to fit the shaft. The reduction of diameter is about one-half inch at the point of greatest wear and this is the result of one season's work. While the process is hastened to some extent by grit, the hay wire is doubtless the chief agent and cases have been mentioned when the screw was actually ground off and dropped from the shaft.



While difficult to prevent, the above practices are most pernicious and should be abandoned and rules against them should be made and enforced.

Depth of water.— The most important improvement, however, and the one on which the prosperity of the boatmen depends most largely, is the establishment of the full depth of water throughout. The effect of low water, and consequently of shoals, is not only to reduce the ratio of section of canal prism to section of boats, already too small, but also to ground a loaded fleet and thus subject it to a greater or less delay until the water can be fed more rapidly to the level.

The formula given by Hon. Elnathan Sweet (Report of State Engineer for 1878) shows that the active force required to propel a boat loaded to draw six feet of water in portions of the canal where the water has shallowed to nearly six feet is thirty per cent greater than when the seven-foot depth has been maintained.

It is there shown that an increased depth of one foot, obtained by raising the banks and structures along the canal, would effect a saving of nineteen hours in the running time between Buffalo and West Troy for single boats loaded to six feet and drawn by two horses. Inasmuch as the present double-headers run at about the same rate as the single boats referred to, an equal advantage might be expected to accrue if the improvement were accomplished, and six round trips could then be accomplished in nine and one-half days less than at present, leaving just so much greater margin of time in which to complete the seventh round trip which we have shown above to be essential to the very existence of the horse-boat traffic, under the present rates of freight obtainable.

But the benefit to be derived by horse-boats from an increased depth of water in the canal would be as great or greater in the case of steam fleets. With the resistance thus decreased fifteen per cent, there would follow a corresponding saving in coal or the same coal consumption would produce a higher rate of speed which might often decide the possibility of making an additional trip in a season.

As already stated, the boatmen have done all that lies in their power. Just how a horse-boatman can reduce his expenses is difficult to imagine. As to the steamers, it is my impression that the useful power bears a somewhat smaller proportion to the power generated in the cylinders, than it would were the engines and screws designed with greater regard to the special service demanded. Much of this work has been entirely empirical and the small changes constantly made would indicate a lack of conviction, on the part of the makers, that things are as they should be. The Illinois and Michigan canal is navigated entirely by steam fleets and the steamers are there provided, almost without exception, with twin screws about four feet in diameter. In this way constant immersion is secured, even with partial loads, while on the Erie canal, the screws of to-day are single, and of a diameter equal to the draught of the steamer when loaded. Thus the screws are never fully immersed, while the average draught of western bound steamers will probably not exceed four feet and one-half, leaving a large portion of the propelling area out of water. But in spite of all this, the steam fleet as a means of transportation is very economical and for a better appreciation of the progress which has been made during the period of twenty years covered by this report, the following table is submitted, in which the various estimates of cost have been so collected as to furnish a ready means of comparison:

Estimated costs of transportation between Buffalo and New York via Erie canal and Hudson river, 1873–1891.

Number.	MODE OF TRANSPORTATION.	Number round trips.	Year.	AVERAGE CARGOES PER BOAT, IN TONS		COST EXCLUSIVE OF TOLLS		
				East.	West.	Per ton, Buffalo to New York.	Per ton, mile.	Per bushel, wheat, Buffalo to New York.
							Mills.	Cents.
1	Single steamer	12	1873	200	......	$2 07	4.18	6.21
2	Single steamer	12	1873	200	50	1 66	3.84	4.97
3	Single steamer	12	1873	200	100	1 38	2.78	4.14
4	Single horse boat	7	1877	230	57.5	1 90	3.88	5.69
5	Single steamer	10	1877	210	52.5	1 92	3.68	5.76
6	Steamer and consort	9	1877	220	55	1 57	3.18	4.72
7	Steamer and consort	10	1877	220	55	1 55	3.18	4.65
8	Single horse boat	7	1877	240	57.5	1 16	2.35	3.48
9	Single horse boat	7	1877	230	57.5	1 35	2.74	4.06
10	Steamer and consort	8	1878	233	118	1 00	2.02	3.00
11	Steamer and consort	8	1878	207	113	99	2.01	2.98
12	Steamer and consort	9	1879	223	115	1 00	2.02	2.99
13	Double-header horse boats	6	1891	250	100	1 08	2.18	3.23
14	Double-header horse boats	7	1891	250	100	98	1.98	2.94
15	Four-boat steam fleets	6	1891	233	142	91	1.85	2.74
16	Four-boat steam fleets	7	1891	233	142	81	1.64	2.44
17	Six-boat steam fleets	5	1891	230	152	94	1.91	2.83
18	Six-boat steam fleets	6	1891	230	152	82	1.66	2.56

These figures speak for themselves. The boatmen have done their best. They have reduced the cost of transportation in horse-boats from 3.83 mills per ton-mile, in 1877, to 1.98 mills per ton-mile, in 1891; from 3.34 mills by single steamer in 1873 to 1.64 mills, in 1891, by four-boat steam fleets, and to 1.66 mills by six-boat steam fleets.

Time Required for Locking Boats.

During the time spent accompanying steamers, notes were taken to determine, as far as possible, the time required for lockage. The following results were obtained from observations upon steamers pushing one boat and towing a double-header; and with the exception of the Cohoes sixteen locks, the locks timed were lengthened on one side. The steamer passes with her consort into the double lock; the two are locked up or down and pass out; the hawser being slacked, if necessary; the lock is then changed and the steamer tows the double-header into the lock, and tows it out when lifted or lowered.

The only data, afforded by our observations, for the time required for passing the sixteen locks at Cohoes, are the records of the steamer James W. Morse and one of her consorts, on the evening of November 24, 1891. The steamer entered lock 15 at 4.55.45 p. m., and lock 4 at 7.41.50 p. m., having made eleven lockages and steamed 2.27 miles, consuming altogether 166 minutes and 5 seconds, and, on an average, fifteen minutes and six seconds per lock and level. The consort, Hon. Elliot H. Danforth, towed by a team of two horses, made a similar trip with a mean period of sixteen minutes and forty-nine seconds per lock and level. As will be seen, later, these periods are very considerably longer than the mean time consumed by fourteen boats timed in 1878. The darkness is the only apparent explanation for this increase. As between the steamer and consort, I believe, the difference is due to longer delays to latter, waiting for locks, and, possibly, to the fact that the steamer can be backed in the lock, free from the lower gate, in case she were not snubbed tight enough, while the horse-boat would have to wait until water might be discharged from the companion lock, to give the boat a slight backward motion and free it from the gate which could then be opened.

In fifteen lockages of loaded fleets drawing six feet of water bound east, it was found that an average of seventeen minutes, thirty-five seconds elapsed from the closing of first gate upon the steamer and consort to the opening of the last one for the tow to pass out. In nine lockages of fleets drawing about four and one-half feet of water, bound west, this period was noted as sixteen minutes.

In seventeen lockages of loaded and partially loaded fleets, like preceding, an average period of twenty-three minutes elapsed from time of slowing for lock to resuming speed after locking. This probably represents about one minute more than the delay caused by the lock and I would, therefore, say that each lengthened lock causes an average delay of twenty-two minutes to a fleet of four boats.

For the Newark locks, our data probably furnish a longer period than would usually be required, owing to a pressure of business. The steamer Carrie Stewart and three consorts slowed down at 12.40 p. m. The fleet was uncoupled and the first boat entered the upper lock at 12.51. The last boat left the lowest of the three locks at 1.48 p. m. and speed was resumed with the fleet reassembled at 2.07 p. m. The total delay was thus one hour and twenty-seven minutes, of which fifty-seven minutes were consumed in locking and passing from lock to lock.

The steamer Acme and three consorts passed up through the five combined locks at Lockport without a hitch of any kind, in what would seem a minimum time of lockage, without extraordinary efforts. In ascending these locks, the steamer enters the first lock ahead, and is locked into the second. The first lock is then changed while the steamer is being raised to the lower level of the third. The steamer then enters the third, towing the first consort into the first, and so on for the fleet, the steamer performing the entire work of towing.

In the case cited, the steamer Acme and fleet slowed down near the foot of the locks at 11.35 a. m., November 2, 1891. The locks were in use at the time and the steamer did not enter lowest lock, No. 67, until 12.01 p. m. The lower gate was closed at 12.04 p. m. The upper gate of the uppermost lock, No. 71, was opened for the release of the fourth and last boat at 1.12.30 p. m. The fleet was reassembled and speed resumed at 1.23 p. m., making a total delay of one hour and forty-eight minutes, of which only one hour, eight minutes and thirty seconds were spent in the actual operations of locking, which were equivalent to filling one lock twenty times and emptying it twenty times, making forty fillings and emptyings, which were performed in an average time of one minute and forty-three seconds, including the time required to open and shut gates and valves and to move the boats from lock to lock. It would appear doubtful, therefore, whether more than twenty fleets of four boats each could be locked per day through a single tier at Lockport continuously, making a probable daily maximum of 160 lockages in all, through both tiers of locks.

To illustrate present practice and to facilitate comparison with the past the following table has been prepared*, showing various statistics for years of heavy traffic, or of largest number of lockages at Lockport, of which record has been preserved and for the four seasons prior to 1891:

YEAR	LOCKAGES AT LOCKPORT.				Average tonnage of new boats on canals.	Tonnage of greater number of new boats.	TOTAL NUMBER OF TONS TRANSPORTED.		Tons on Erie canal per lockage at Lockport.
	Total number in season.	Daily average for season.	Daily average for largest month.	Largest number in one day.			On all canals.	On Erie canal.	
1861........	25,261	113	146	207	154	200	4,507,635	2,500,782	99
1862........	**30,908	138	162	210	168	200	5,598,785	3,204,277	104
1864........	19,622	89	112	189	141	200	4,852,941	2,535,792	129
1865........	19,589	87	101	187	144	200	4,729,654	2,523,490	129
1869........	15,740	72	94	178	157	240	5,859,080	2,845,072	181
1870........	16,623	78	93	120	157	240	6,173,769	3,083,182	185
1871........	21,062	96	118	†	151	240	6,467,888	3,580,922	170
1872........	21,956	108	131	†	178	240	‡6,673,370	3,562,560	162
1873........	21,662	106	131	†	184	240	6,364,782	3,602,585	170
1878........	20,814	88	129	†	161	240	5,171,320	3,608,634	173
1879........	23,286	110	140	†	169	240	5,362,372	3,820,047	170
1880........	25,170	117	123	†	212	240	6,457,656	§4,608,651	183
1881........	17,124	83	108	†	188	240	5,179,192	3,598,721	210
1887........	19,757	95	107	†	218	250	5,553,805	3,840,518	199
1888........	16,097	77	103	†	220	250	4,942,948	3,321,516	206
1889........	17,961	84	110	†	205	250	5,370,369	3,673,554	205
1890........	16,980	78	93	†	229	250	4,563,472	3,303,929	195

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* From reports of Auditor and Superintendent of Public Works for years named. ** Greatest number in any season. † Not mentioned in reports subsequent to 1870. ‡ Greatest total tonnage for all canals. § Year of greatest tonnage on Erie.

The very large number of lockages at Lockport in 1862, viz., 30,908, making a daily average of 138 for the whole season, with a maximum number of 210 in a single day, fifty more than above estimated as practicable to-day, continuously, would indicate that either the estimate is wrong or the circumstances are now different, and I would call your attention to the sixth, seventh, eighth and ninth columns of the table in explanation of the discrepancy. The total Erie canal tonnage is employed in absence of any statistics showing the tonnage passing through the Lockport locks.

The average tonnage of new boats and the tonnage of greater number of new boats are employed in absence of any records showing the average tonnage of boats passing through the locks in question. From these columns it is seen that whereas in 1861 and 1862 the average new boat was of about 160 tons capacity, and the tendency was to build 200-ton cargo boats, in 1890 the average tonnage of new boats was 229, and the tendency was toward boats carrying 250 tons. Further examination of the tables on pages 335-342 of Report of Superintendent of Public Works for 1890, shows that for five years prior to 1866 the popular tonnage was 220. In this year the construction of 240-ton boats received its first impetus.

Bearing these facts in mind, we find that in 1861 and 1862, there were transported 99 and 104 tons over the Erie canal for each lockage at Lockport, while for the last five years there have been transported an average of 203 tons for each lockage at Lockport. Whereas a canal tonnage of 3,204,277 in 1862 required 138 lockages each day for the whole season, 3,303,929 tons were transported in 1890 with only seventy-eight lockages per day. The bulk of Erie canal traffic is carried in full-sized boats and as in most artificial or artificially adjusted waterways, the tendency has been to construct boats as large as permitted by the structures. The result has been that boats so nearly fit the locks that when one enters, there remains a very constricted channel for the liberation of the water already in the lock, and a very considerable portion of the time required for locking is consumed in entering the lock. We are, therefore, justified in assuming that the same number of lockages of laden boats of the average tonnage could not be made to-day as in 1862, although the tonnage per day could be made very much larger.

The facts above elicited will justify, in my belief, the foregoing estimate of 160 lockages of full-sized boats as the maximum number which could ordinarily be made continuously through the season of navigation.

Theoretical quantity of water consumed in locking.

CONDITION.	QUANTITY OF WATER TAKEN FROM UPPER LEVEL FOR ONE BOAT.	
	In a series of *n* combined locks of same lift.	In a single lock with pondage.
When the boat descends, after one has ascended	(n-1) L+S	S
When the boat ascends, after one has ascended	2 L—S	2 L—S
When the boat ascends, after one has descended	n L—S	L—S
When the boat descends, after one has descended	S	S

In which n = Number of combined locks.

L = Volume of water required to fill one lock through a height equal to the common lift.

S = A volume of water equal to the difference between L and the displacement of the boat.

It will be observed that the quantities of water used in a single lock may be derived from the expressions for the combined locks by substituting 1 for n.

From the above, it is apparent that having given a canal with all double locks, some combined and some single, the least water will be used by always locking in the same direction through the combined locks and alternating the direction of lockage through the single locks, and, other things being equal, the least time will be wasted by following the same principle.

Capacity of the Erie Canal.

From the preceding discussion of the time and manner of locking data are afforded for an estimate of the present carrying capacity of the canal.

Under present conditions the through capacity is determined by the capacity of the Lockport locks. The greatest amount which can be locked through at this point in a given time is the capacity of the canal for through freight.

If, then, we assume that the freight is to be carried in four-boat fleets, the cargoes would amount to 930 tons per fleet; if twenty fleets be locked through, the daily tonnage would be 18,600, and the total for a season of 214 days would be 3,980,400, say 4,000,000 tons.

Assuming each fleet to make seven trips in a season, there would be required for this business 611 four-boat fleets of steamer and three consorts, or 400 six-boat fleets of steamer and five consorts.

There ought, however, to be no difficulty in making eight trips per season, with proper terminal facilities. In this case there would be required 535 four-boat fleets or 348 six-boat fleets.

The yearly capacity above estimated is for through tonnage in an easterly direction only. The direction, character and amount of traffic during the past season is as follows:

TONS OF 2,000 POUNDS.	East.	West.	Total.
Through	2,043,567	608,271	2,651,838
Way	1,147,064	764,570	1,911,634
Total	3,190,631	1,372,841	4,563,472

If the same proportions were to be maintained for the Erie alone, on the basis of 4,000,000 tons through freight carried east, the traffic would be, approximately, twice as great, thus:

TONS OF 2,000 POUNDS.	East.	West.	Total.
Through	4,000,000	1,200,000	5,200,000
Way	2,300,000	1,500,000	3,800,000
Total	6,300,000	2,700,000	9,000,000

This total of 9,000,000 tons must not be construed as an estimated maximum. If 4,000,000 tons could be carried east, the same boats could carry 4,000,000 tons west, making a through tonnage of 8,000,000, to which must be added the way-freight which might be transported between Buffalo and Lockport, and

Lockport and Albany, before an actual maximum for the Erie canal can be computed. It is, however, impossible to make any estimate of this item of way-freight other than as above.

Tolls, Trade and Tonnage, New York State Canal.

In the following table are shown various statistics derived from the Annual Reports on Tolls, Trade and Tonnage of the Canals, by the auditor of the canal department prior to 1883, and subsequently by the Superintendent of Public Works. Except as to the number of boats running at any time, I have been unable to find any continuous record of this matter, but in the Report of the State Engineer and Surveyor for 1862, on page 461, the statement was made that careful inventories had been made during the month of January, in the years 1844, 1847, 1853 and 1859, with these results:

Whole number of boats, January, 1844................	2,126
Whole number of boats, January, 1847................	2,725
Whole number of boats, January, 1853................	3,401
Whole number of boats, January, 1859................	3,867

In the State Engineer's Report for 1883, the statement was made that there were about 4,000 boats then engaged in transportation upon the State canals, of which ninety-two were propelled by steam.

The registry record not running back further than 1844, there are only three of the above statements available for determining the average life of boats, preliminary to computing the number of boats running at any time. Thus it is found that from 1844 to 1852, inclusive, there were registered 2,926 new boats, and, as there were actually 3,401 boats running in 1853, it follows that about 475 boats built prior to 1844, were still in use. In 1844, 378 boats were registered, and it is probable that the number built in 1843 was not greatly different. Thus the average life of boats in 1853 was about ten years. Again there were registered from 1849 to 1858, inclusive, 3,620 boats, while the number running at the end of 1858 was 3,867. The average life at this time would consequently be somewhat more than ten years. In 1883 there were 4,000 boats running, and to obtain this number, we must include all boats registered as far back as 1868, making the average life between fifteen and sixteen years.

Yet as late as 1877, Messrs. Case, Beadle and Case estimated the life of horse-boats at ten years.* I have therefore estimated the number of boats running on the canals for the years 1854 to 1870, inclusive, on a basis of ten years' life and from 1880 to 1890, inclusive, on a basis of fifteen years' average life. Although only approximate, the results obtained are most interesting.

It should be remembered that the boat tonnages given represent the weights of cargoes carried in tons of 2,000 pounds, and as all the tonnages were derived from documents employing these tons, it is presumed that they are uniform in meaning throughout.

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* State Engineer's report for 1878, pp. 29-31.

YEAR.	NEW BOATS.		Estimated number of boats running on canals.	TONS TRANSPORTED.		Average mileage per ton, all canals.	Ton-mileage of all canals.	YEARLY AVERAGES ON ALL CLASSES OF FREIGHT.					Freight per bushel of wheat, Buffalo to New York, exclusive of tolls.
									ALBANY TO BUFFALO.		BUFFALO TO ALBANY.		
	Number.	Average cargoes.		On all canals.	On Erie canal.			Freight per ton mile, including tolls.	Tolls per ton.	Freight per ton exclusive of tolls.	Tolls per ton.	Freight per ton exclusive of tolls.	
								Mills.					
1830	....	....	......	....	....	....	....	....	$10 22	$9 78	$5 11	$3 96	....
1831	....	....	......	....	....	....	....	....	10 22	9 58	5 11	3 78	....
1832	....	....	......	....	....	....	....	....	10 22	9 78	5 11	4 15	....
1833	....	....	......	....	....	....	....	....	8 76	6 04	3 65	4 50	....
1834	....	....	......	668,483	....	....	....	....	6 57	9 83	3 28	4 40	....
1835	....	....	......	....	....	....	....	....	6 57	9 43	3 28	3 01	....
1836	....	....	......	....	....	....	....	....	6 57	14 43	3 28	3 85	....
1837	....	....	......	1,171,296	667,151	....	....	....	6 57	12 08	3 28	4 22	....
1838	....	....	......	1,333,011	744,848	....	....	....	6 57	11 23	3 28	3 48	....
1839	....	....	......	1,435,713	845,007	....	....	....	6 57	11 23	3 28	3 62	....
1840	....	....	......	1,416,046	829,960	....	....	....	6 57	10 08	3 28	4 22	....
1841	....	....	......	1,521,661	906,442	....	....	....	6 57	5 63	3 28	3 29	....
1842	....	....	......	1,236,931	712,310	....	....	....	6 57	6 63	3 28	2 74	....
1843	....	....	*2,126	1,513,439	819,216	....	....	....	6 57	4 63	3 28	2 28	....
1844	378	64	......	1,816,586	945,944	....	....	....	6 57	6 43	3 28	2 [illegible]	....
1845	297	67	......	1,977,565	1,038,700	....	....	....	6 57	8 08	3 28	3 29	....
1846	477	73	*2,725	2,268,662	1,264,408	....	....	....	4 80	3 20	2 92	3 00	....
1847	466	76	......	2,869,810	1,661,[illegible]75	....	....	....	4 80	3 00	2 92	4 21	....
1848	457	74	......	2,796,230	1,599,965	....	....	....	4 80	3 00	2 92	2 45	....
1849	215	76	......	2,894,732	1,622,444	....	....	....	4 80	3 00	2 92	2 [illegible]	....
1850	152	80	......	3,076,617	1,635,089	....	....	....	4 80	2 40	2 92	[illegible]	....
1851	218	87	......	3,582,733	1,955,265	....	....	....	4 40	1 80	2 19	[illegible]	....
1852	271	88	*3,401	3,864,441	2,129,834	....	....	....	2 93	[illegible]	2 19	[illegible]	....
1853	590	97	......	4,247,853	2,196,808	....	....	....	2 92	[illegible]	2 19	[illegible]	....
1854	160	105	3,516	4,165,862	2,234,008	....	....	....	2 92	[illegible]	2 19	[illegible]	
1855	471	102	3,898	4,022,617	2,202,463	....	....	....	2 92	[illegible]	2 19	[illegible]	
1856	364	107	4,072	4,116,082	2,107,678	144	592,009,603	11.1	2 93	[illegible]	2 [illegible]	[illegible]	
1857	329	114	3,959	3,344,061	1,566,634	145	484,730,864	7.99	2 92	[illegible]	[illegible]	[illegible]	
1858	255	109	*3,867	3,665,192	1,767,004	154	564,842,695	[illegible]	1 [illegible]	1 [illegible]	[illegible]	[illegible]	
1859	206	98	3,620	3,781,684	1,753,954	141	544,309,072	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
1860	403	120	3,611	4,650,214	2,253,533	174	[illegible]	[illegible]	1 [illegible]	1 [illegible]	[illegible]	[illegible]	
1861	619	154	3,862	4,507,635	2,500,782	192	[illegible]	[illegible]	1 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1862	850	168	4,268	5,598,785	3,304,277	301	1,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

YEAR.	New Boats.		Estimated number of boats running on canals.	Tons Transported.		Average mileage per ton, all canals.	Ton-mileage of all canals.	Yearly Averages on all Classes of Freight.					Freight per bushel of wheat, Buffalo to New York, exclusive of tolls.
	Number.	Average cargoes.		On all canals.	On Erie canal.			Freight per ton mile, including tolls.	Albany to Buffalo. Tolls per ton.	Albany to Buffalo. Freight per ton exclusive of tolls.	Albany to Buffalo. Tolls per ton.	Albany to Buffalo. Freight per ton exclusive of tolls	
								Mills					
1863	771	177	4,847	5,557,692	2,955,302	183	1,034,130,023	6.76	1 40	1 10	2 11	2 06	0918
1864	399	141	5,028	4,852,941	2,535,792	180	871,335,150	11.5	1 05	1 55	2 11	3 21	1257
1865	290	144	4,667	4,729,654	2,523,490	178	843,915,779	11.0	1 05	1 45	2 11	2 61	1068
1866	485	154	4,396	5,795,220	2,906,027	174	1,012,448,034	10.0	1 05	1 55	2 11	2 71	1075
1867	520	155	4,517	5,688,325	2,920,578	168	958,[illegible]62,953	9.0	1 05	1 55	2 11	2 33	0948
1868	387	16[illegible]	4,7[illegible]8	6,442,225	3,346,966	161	1,033,751,268	8.8	1 05	1 55	2 11	2 33	0944
1869	298	157	4,840	5,859,080	2,845,072	157	919,153,611	9.2	1 05	1 55	2 11	2 61	1010
1870	269	157	4,932	6,173,769	3,083,132	147	904,351,572	8.3	1 05	1 55	1 05	2 01	0812
1871	194	151	......	6,467,888	3,580,922	162	1,050,104,125	10.2	1 05	1 55	1 05	2 65	0952
1872	326	178	......	6,673,370	3,562,560	157	1,048,575,911	10.2	1 05	1 55	1 05	2 65	1000
1873	433	184	......	6,364,782	3,602,535	166	1,057,711,089	8.8	1 05	1 55	1 05	2 28	0847
1874	239	183	......	5,804,588	3,097,122	162	938,774,141	7.3	1 05	1 55	1 05	1 73	0701
1875	1[illegible]2	171	......	4,859,858	2,787,228	150	727,597,364	6.6	1 05	1 55	70	1 48	0594
1876	75	144	......	4,172,129	2,418,422	137	570,969,064	6.8	1 05	1 55	70	1 84	0 65
1877	69	1[illegible]3	......	4,955,963	3,254,367	173	857,80[illegible],563	5.7	1 05	1 55	37	1 57	0636
1878	300	161	......	5,171,320	3,608,634	181	987,789,464	4.2	1 05	1 55	37	1 11	0496
1879	382	169	......	5,362,372	3,820,027	180	962,908,600	4.6	1 05	1 55	37	1 48	0593
1880	439	212	4,718	5,457,656	4,608,651	224	1,223,599,087	4.9	18	1 3[illegible]	35	1 35	0547
1881	368	188	4,[illegible]86	5,179,192	3,598,721	198	†1,023,750,000	3.8	‡	1 50	37	[illegible]4	0885
1882	93	143	4,494	5,467,423	3,691,364	§112	§582,033,028	§4.2	....	1 20	37	92	0485
1883	76	149	4,050	5,664,056	3,[illegible]87,102	....	....	....	....	....	‡	....	0488
1884	60	166	3,723	5,009,488	3,389,555	....	....	....	....	....	....	....	0420
1885	84	164	3,459	4,731,784	3,208,207	....	....	....	....	....	....	....	0381
1886	58	208	3,248	5,293,982	3,808,642	....	....	....	....	....	....	....	0508
1887	157	218	3,206	5,553,805	3,840,513	....	....	....	....	....	....	....	0444
1888	85	220	3,065	4,942,948	3,321,516	....	....	....	....	....	....	....	0341
1889	58	205	2,690	5,370,369	3,673,554	....	....	....	....	....	....	....	0437
1890	77	229	2,528	5,[illegible]46,102	3,303,929	....	....	....	....	....	....	....	0387
1891	....	....	‖	4,563,472	3,097,853	....	....	....	....	....	....	....	0349

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* As inventoried; others estimated. † Approximate, with little probable error. Of the total tonnage given the fifth column for 1881, 4,937,6[illegible]6 tons paid toll, with a ton-mileage of 563,498,886. ‡ Tolls were removed from west-bound freight in 1881 An amendment to the State Constitution taking effect January 1, 1883, provided that "no tolls shall hereafter be imposed on persons or property transported on the canals" § In 188[illegible], of the total tonnage given in the fifth column, 5,219,388 tons paid toll. The quantities in the seventh, eighth and ninth columns apply only to this tonnage. ‖ 2,426 + 1891 boats.

The "Belgian System" on the Erie Canal.

As heretofore remarked, there have been a large number of attempts to establish a value for various devices designed to facilitate or cheapen the cost of transportation on the canals. Screw propellers and paddle-wheels have been applied to boats in such a variety of positions that a new kind of boat would be necessary to produce a new combination. But all such efforts resulted in appliances whose efficiency depended upon the slip of the propeller, through the water. In another class of inventions, it was sought to avoid this loss by deriving the fulcrum from the ground. Among these may be mentioned the following methods of propulsion:

1. Towing by locomotive running on towpath.
2. Towing by steamboats gripping a stationary cable lying along the bottom of the canal.
3. Steamboat propelled by wheel running on bottom of canal.
4. Steamboat propelled by driving wheel running on a single track laid along towpath.

These methods have all been given trials of greater or less duration on the State canals, but only the second one met with a measure of success sufficient to warrant discussion at this time. This is known as the "Belgian System," and having been very successfully employed in the navigation of European rivers, especially those having swift currents, a company was formed for the purpose of demonstrating its applicability to the Erie canal and its utility in decreasing the cost of transportation.

I present abstracts from various sources, which are self-explanatory and constitute the official history of the undertaking.

The result may be thus summarized:

Under legal authorization a cable was laid in 1872 on the bottom of the canal between Buffalo and Lockport, the cable occupying thirty-one miles of canal, by a private company, the New York Steam Cable Towing Company. During the season of 1873 two cable tugs were in operation. On February 17, 1874, a report was made by Hon. D. M. Greene, which concluded with the suggestion that practical difficulties remained unsolved in operating a cable through the whole length of the canal, that the duration of a trip of cable boats between Buffalo and New York must be considerably greater than that of a steamer, and that the elements of interest upon cost of cable, the uncertain extent of its annual depreciation and cost of repairs remained for future determination.

In 1877, Hon. Horatio Seymour, Jr., State Engineer, in his annual report, made the following estimate of cost by this system, exclusive of tolls:

Cost per ton, Buffalo to New York, eight trips, $1.741; nine trips, $1.596.

Cost per ton, mile, eight trips, 3.52 mills; nine trips, 3.22 mills.

Cost per bushel of wheat, Buffalo to New York, eight trips, 5.22 cents; nine trips, 4.79 cents.

This estimate was based upon the assumption of a cable through the entire length of the Erie canal, upon all eastward movement of 3,000,000 tons and a westward movement of 750,000 tons, and upon an investment of the cost of the cable, of 240 towing tugs for eight round trips per season or 180 tugs for nine round trips, with charges for interest, repairs and maintenance.

In Mr. Seymour's report for 1879, there is included a report on the cable towing system as then in operation, made by Division Engineer Thomas Evershed. There were then, December, 1879, eighty miles of cable all on the western division of the Erie canal, and extending from Buffalo to Rochester, with the exception of twelve miles on Tonawanda creek. There had been a cable in this creek but it had been made useless by snags and sunken logs. There were in use ten towing tugs. Upon a trial trip the time made from Buffalo to Rochester was forty hours ten minutes; less lockages and transfers, six hours forty-one minutes; towing time, including delays in passing boats, thirty-three hours twenty-nine minutes.

The fastest time was four miles per hour, the slowest two miles per hour. Six boats were towed part of the distance and five boats all the distance. The speed was equal to that of a steamer and one consort.

In his annual report for 1880, Assembly Document No. 38, 1881, Superintendent of Public Works S. B. Dutcher, said:

"Complaints from boatmen have been presented, regarding delays to navigation and injury to their boats, by the boats of the

New York Steam Cable Towing Company. These complaints became very frequent and in many instances accompanied by affidavits and demands for the removal of the cable. I appointed two men of much experience to carefully and thoroughly investigate the working of the said cable boats and transmit herewith a copy of their report. The statements therein of injury to the banks and structures, and delays to navigation are confirmed by other parties who have witnessed the results during the past season. Its workings are entirely impracticable, and the attention of the Legislature is called to the matter as one which should receive their early and earnest consideration. In my judgment, the act permitting the introduction of this system of towing should be repealed."

The report referred to by Mr. Dutcher, is dated December 10, 1880, and is made by R. D. Ford, of Buffalo, and E. C. Roberts of New London. It states that the cable then laid was:

Buffalo to Tonawanda, miles	12
Pendleton to Lockport, miles	7
Lockport to Rochester, miles	62
Lodi Lock to Utica Lock, miles	52
Total miles	133

During the season only that portion from Buffalo to Tonawanda, that from Lockport to Rochester, and thirty-four miles from Lodi Lock to New London, in all 108 miles were in use.

The report states that the principal difficulty was in the sharp curves or bends of the canal where the cable was always found hard to shore on the short side of the bend and frequently on the top of the towpath or berme bank. Then the towing tug is forced against the bank and passes the bend with great difficulty, the tug and tow raking hard on shore, pulling off docking, masonry, stone from slope walls, earth, sod and gravel, and causing them to fall into the canal. Great damage had also been done to the bridge abutments upon berme bank bends. The two systems of cable towing and towing by steam propellers work very inharmoniously.

The report illustrates the difficulties connected with the tow lines of other than cable boats when passing the cable tows. It also states that the cable boats unexpectedly sheer at times into boats they meet, owing to the cable being left out of position by the last boat using it, or caught upon a rock or boulder on the bottom. The speed of the cable tows being greater than that of horse-boats, results in frequent passings and many horse-boats have been then damaged. When the cable, at sharp bends has been left on the banks it frequently fouls the next boat causing damage and leaks. Detentions occur at locks, also when cable tows, going in opposite directions, meet. Damage has also been done to boats lying at warehouses, coal yards, etc. on berme bank bends.

This report also states that the cable boats actually took longer time to convey the cargoes than the steam propeller fleets and even than the boats towed by horses — and that the cost was greater.

The recommendation of the Superintendent of Public Works was adopted, the system abandoned and the cable removed.

Champlain Canal Transportation.

General description of canal.

The Champlain canal forms the connecting link between the waters of Lake Champlain, at Whitehall, and those of the Hudson river at Waterford, and the Erie canal at West Troy. The canal is about sixty-six miles long, with a channel of present minimum depth of five feet. The standard improved section of prism is forty-four feet wide at bottom, with six feet depth of water and sixteen miles of the canal are so improved. The locks on canal proper are twenty-three in number, of which four are guard-locks proper; twelve are locks lifting northerly between Cohoes and Fort Edward, with an aggregate lift of about 122 feet; and seven are locks lowering northerly, between Fort Ann and Whitehall. They are all single, with chambers 110 feet long and eighteen feet wide. The water supply is derived from the Hudson river between Fort Ann and Cohoes, the summit level between Fort Ann and Fort Edward being supplied by the navigable feeder, twelve miles in length, tapping the Hudson river at Glens Falls. The Hudson is crossed at surface, at Northumberland (Saratoga dam), and the Mohawk river is similarly crossed at Cohoes. Between Cohoes and the junction with the Erie canal at West Troy the supply is derived from the Mohawk river. From Fort Ann to Whitehall the supply is derived from Wood creek, and from the summit level.

Trade and tonnage.

The traffic on this canal consists largely of lumber, coal and iron ore; the coal being carried north to lake ports and Canada, and the lumber and ore brought south. During the season of 1890, there were transported on this canal:

	Tons	Per cent.
Of all articles	1,521,000	100
Lumber	391,000	....
Coal	260,000	....
Iron ore	202,000	....
	853,000	56
Other classified articles	150,000	10
Unclassified merchandise	518,000	34

The tonnage of the canal for each year since and including 1837 is shown in following table. During this period of fifty-five seasons there were transported on the Erie canal, in round numbers, 136,730,000 tons, and on the Champlain canal 43,450,000 tons, or thirty-one and eigth-tenths per cent of the tonnage of the Erie. A comparison between this table and the one on a previous page, shows that this ratio has varied remarkably little.

When it is considered that this canal is two feet shallower than the Erie, with a section of prism only one-half as large; that the locks are not only single but unlengthened; that the canal is only sixty-six miles long to the Erie's 352, and that there are only six villages of even moderate size along its line, this maintenance of traffic stands as a worthy commentary upon its usefulness and importance, and a remonstrance against further delay in its improvement.

Tonnage of the Champlain Canal, 1837–1891.

Year.	Tons.
1837	261,659
1838	266,553
1839	263,552
1840	245,229
1841	276,418
1842	230,844
1843	262,212
1844	269,546
1845	266,922
1846	280,480
1847	313,124
1848	293,889
1849	321,345
1850	460,219
1851	513,793
1852	531,001
1853	608,354
1854	602,913
1855	537,108
1856	611,610
1857	547,236
1858	608,918
1859	751,046
1860	681,157
1861	545,930
1862	647,318
1863	879,920
1864	846,790
1865	815,311
1866	1,001,493
1867	1,047,440
1868	1,120,585
1869	1,059,334
1870	1,143,719
1871	1,099,995

Year.	Tons.
1872	1,449,528
1873	1,195,390
1874	1,268,292
1875	1,077,746
1876	910,151
1877	1,021,782
1878	1,040,912
1879	1,012,005
1880	1,200,503
1881	986,079
1882	1,097,343
1883	1,366,358
1884	1,118,073
1885	1,139,402
1886	1,119,663
1887	1,229,335
1888	1,198,305
1889	1,187,038
1890	1,520,757
1891	1,101,123

In the year 1872, the total tonnage of the State canals reached a maximum which has not since been equalled. The above table shows this to have been the case on the Champlain canal, if we except the year 1890, in which the failure of the ice crop south of Troy caused the harvesting of an enormous amount of ice on Lake Champlain, of which nearly 408,000 tons were brought south over this canal.

Transportation.

The only improvement in the means of transportation over this canal has been the increase in capacity of boats. The maximum draught permitted is four feet four inches, making about 155 tons the maximum allowable cargo for a full-sized boat.

The towing is still done entirely by animal power and is almost entirely in the hands of two companies, controlling together between 450 and 500 horses and mules. The double-header system is being slowly adopted, possibly seven per cent of the boats being run in this fashion, but the development of the system is of course retarded by the fact that none of the locks have been lengthened. These companies usually employ teams of three animals to each boat, whether single or double, teams being changed every twelve miles or thereabouts.

For boats thus handled, the time through the canal is as follows:

Light boats, either way	30 hours.
Loaded boats, going north	55 hours.
Loaded boats going south	50 hours.

The tariff charges for towing during the season of 1891 were as follows:

For loaded boats, Troy to Whitehall	$25
For loaded boats, Waterford to Whitehall	22
For loaded boats, Whitehall to Troy	23
For loaded boats, Whitehall to Waterford	20
For light boats, Troy to Whitehall	15
For light boats, Waterford to Whitehall	12

Competition will lower these charges somewhat, but the general average is probably about thirty cents per loaded boat per mile.

Boats having passed through the canal, continue their trips in the manner described hereafter, either on Lake Champlain or the Hudson river.

Transportation between Whitehall and Montreal.

From Whitehall, the line of traffic by water extends through what are known as Whitehall narrows, eighteen miles to the open lake, thence northerly through the lake, 111 miles, to its outlet, the Richelieu river, at Rouses Point; thence entering the Dominion of Canada down the Richelieu river, twenty-three miles to St. Johns, P. Q., the southern terminus of the Chambly canal; thence by canal around the Richelieu rapids twelve miles to Chambly basin; thence down the river forty-six miles to Sorel where it empties into the St. Lawrence; thence up the river forty-six miles to Montreal, where the lines diverge through the various waterways to different portions of the Dominion.

This route will be considered in three sections, viz.:

Between Whitehall and St. Johns.

Between St. Johns and Chambly.

Between Chambly and Montreal.

Between Whitehall and St. Johns.

The towing on this portion is engaged in nominally, by four companies, but is practically controlled by two, the Lake Champlain Transportation Company and the New York and Lake Champlain Transportation Company, by whom the Champlain canal towing is also done.

Motive power.— In the accompanying table of "Data respecting towing steamers," are given the details of the fleet of Lake Champlain towing steamers. These are seven in number (exclusive of launches doing a little local towing), the smallest one being employed between Rouses Point and St. Johns. The other six are supplied with high class condensing engines, four of them being compound. The steamers are of excellent workmanship, well fitted up and maintained with scrupulous care, and will compare favorably with steamers in similar service anywhere. The screws carried vary from eight to 8.5 feet in diameter, with from ten to twelve feet pitch. One steamer is supplied with beam pumps attached to cross-head of main engine, but the others use independent pumps for air and circulation. Crews of from six to eight men are carried and every arrangement is made for their comfort.

Consumption of fuel.— The fuel employed is anthracite pea coal. The average consumption reported is for the two best boats, 8.7 pounds of coal per loaded boat per mile, at a speed of four miles per hour through the water; for three others, this quantity averages 15.7 pounds per loaded boat per mile, at only 3.5 miles per hour. While it is certain that some are more efficient than others, this difference is larger than would be expected.

Speed and time of trip.— The speed of tows varies from three to four miles per hour, depending upon the size of tow. The average tow is from fifteen to eighteen boats; the heaviest one brought to Whitehall during the season of 1891, was composed of forty-two loaded boats. The running time between Whitehall and St. Johns varies from forty to forty-eight hours.

Manner of handling tows.— Tows are made up usually, with two boats abreast, the odd boat ahead, although with a large tow coming south the boats may be put three abreast. The hawsers are seven inches in circumference and about fifty feet long through the narrows from Whitehall to the open lake, where they are lengthened out to 500 or 600 feet.

Towing rates.— During the season of 1891 the charges were twenty dollars per boat each way, between Whitehall and St. Johns.

Between St. Johns and Chambly — on Canal.

The Chambly canal affords a channel around the rapids of the Richelieu river between St. Johns and Chambly basin. It is twelve miles in length, thirty-six feet wide on bottom, sixty feet at water surface and seven feet deep. The locks are nine in number with an aggregate lift of seventy-four feet; 118 feet long, and 23.5 feet wide, accommodating vessels 110 feet long and twenty-three feet wide. The maximum cargo is 230 tons and allowed draught is 6.5 feet. Work was commenced on this canal in 1831, suspended in 1835, resumed in 1840, and completed in 1843.

The towing is done by animal power, controlled by individuals, at a charge of two dollars and fifty cents per team through the canal.

Between Chambly Basin and Montreal.

At Chambly Basin the boats are made up into fleets, averaging from ten to fifteen boats, and towed by steamers down the Richelieu river, thirty-two miles to St. Ours dam and lock; thence fourteen miles to Sorel and up the St. Lawrence forty-six miles to Montreal.

The towing between Ottawa, Quebec and Chambly is practically controlled by one company, the "Sincennes-McNaughton Line, Limited," ninety per cent of the work being done by them. The present fleet of this company is described in accompanying table of "Data respecting towing steamers," Nos. 8 to 19 inclusive. The engines are of various types. The fuel used is soft coal, the reported average consumption with a tow of about thirteen boats being fifteen tons from Montreal to Chambly, at a speed of about 3.68 miles per hour and twenty tons from Chambly to Montreal at a speed of about 2.3 miles per hour, over the ground, or at the rate of about twenty-five pounds per boat per mile at a speed of three miles per hour through the water.

Tows are made up in Chambly Basin with two boats abreast, and this arrangement is preserved until the fleet has passed between the piers of the railroad bridge crossing the river at Beloeil, when the boats are usually placed four abreast, to shorten the tow and facilitate management, in the swift current. This method is always adopted from Beloeil bridge to Sorel, during the time of high water in the spring.

The lock at St. Ours is 200 feet long and forty-five wide in chamber, with seven feet of water over the sills. Three canal boats are locked through at once, assisted by teams, for the use of which there is a charge of twenty-five cents per boat.

The boats are towed two abreast from Sorel to what is known as the "St. Mary current," near the lower end of Montreal. At this point the fleet is broken up and boats are towed in bunches of three or four at a time to the foot of the Lachine canal, through which they are towed by smaller tugs.

Returning from Montreal to Sorel, small tows are made up, with two boats abreast; larger ones, with two boats ahead, then three abreast, and thereafter four, but never more.

Between Montreal and Sorel, the hawsers are run out to 500 and 600 feet; but between Screl and Chambly they are necessarily much shorter.

The running time from Montreal to Chambly, with a fleet of from ten to fifteen boats, varies between twenty-four and thirty hours, the return trip being made in forty to forty-five hours, from which it is inferred that the average speed maintained is about three miles per hour through the water.

The charges for towing boats with Champlain canal loads of 125 or 130 tons are: From Montreal to Chambly, twenty dollars; from Chambly to Montreal, twenty-four dollars.

It is customary with many boatmen to load to five and one-half or six feet draught between Montreal and Whitehall, discharging part of the cargo at the latter place, or increasing it, if going north. For such boats an increase of five dollars is charged from Montreal to Chambly, and from Chambly to Montreal the increase is twenty cents per ton for all loads over 130 tons.

The tolls on lumber, the principal article of export from Canada, by this route are as follows: From Ottawa to St. Johns, per ton, twenty cents; from Montreal to St. Johns, per ton, ten cents.

I am indebted to the officers of the Sincennes-McNaughton Line, of the New York and Lake Champlain Transportation Company, and of the Lake Champlain Transportation Company for many courtesies and for the trouble taken to afford desired information and facilities for examination of their fleets.

Towing on Hudson River between Albany and New York.

Canal boat and barge transportation on the Hudson river may be divided into four classes, as follows:

1. Large fleets towed between Albany and New York by regular lines of steamers.
2. Fleets towed between Albany and New York by "tramp" or individual steamers.
3. Fleets towed between Rondout and New York by line.
4. Small fleets of canal boats, self propelled, between Albany and New York.

1. Large fleets by regular lines.— These fleets are made up at Albany and are composed of boats which have either come through the canal to Albany or have left the canal at Waterford or West Troy and have been towed to Albany by small tugs. Here they are made up into fleets with four or five boats abreast and from five to twenty-five boats long, the whole being securely lashed together by hawsers five or six inches in circumference, into a compact mass of from 20 to 115 boats, according to the condition of traffic. The towing steamer makes fast by three haw-

sers (in the case of large tows), six and one-half inches in circumference, attached to the outside and middle boats respectively, and run out to a length of 600 to 720 feet. The extreme length of tows will thus vary between 1,300 and 3,500 feet, including steamer. In this manner the river is descended until the upper part of New York is reached. Here the boats begin to drop off, without stopping the tow, and are picked up by tugs which hover about, and towed to their respective berths. At the lower end of the city, the hawsers are shortened up and the tow rounds the Battery. The remaining boats are landed at the canal basin and docked by the aid of tenders.

In making up tows for the return trip this process is reversed. The towing steamer makes fast to the dock and the tow is made up by tenders, and starts up the river slowly, accumulating the boats along the city front. They next proceed up the river and are met below Albany by tenders and various tugs which assist in breaking up the tow and docking the various boats or which take them in small numbers to Troy where the canal is entered.

This description applies generally to fleets towed by either screw propellers or side-wheel steamers. The propellers, however, possess the advantage of being able to dock their tows without the assistance of tenders.

Prior to the fifth of July last there were three regular lines engaged in this transportation. One, the Schuyler line, employed fifteen tow-boats, nine of which were side-wheelers, and six propellers. The largest of the side-wheelers was 310 feet long, forty-two feet wide and drew eight feet of water, costing $75,000, and the capital invested amounted to about $500,000. Tows by this line would average fifty boats and an average time of eighty-two hours was required for the round trip. The coal consumption is given as about 150 tons (anthracite pea coal) per round trip. This company suspended business on above date and there are now but two companies engaged in a regular towing business between the two cities. The Ronan Towing Company employ thirteen tow-boats, all of which are screw propellers. The larger boats, four in number, are 120 feet long, twenty-six feet wide and draw eleven feet of water, costing about $50,000. The engines are compound, with cylinders twenty-four and forty-two inches in diameter and thirty-six inch stroke. The smaller boats are about ninety feet long, twenty feet wide and draw eight and a half or nine feet of water, and cost from $15,000 to $25,000. The greater portion of these boats is owned by this line and the capital invested including the value of the chartered boats, is about $500,000. Tows by this line average about fifty boats and the time consumed in making a round trip is about ninety-six hours. The third company is known as the Cornell Towing Company. (See Rondout Line, below.)

The charges for towing a canal boat between Albany and New York are twenty-five dollars per trip loaded, and fifteen dollars per trip light.

2. "Tramp" or individual towing.— This branch is engaged in by various steamers which, as their name indicates, tow from place to place, as best they may. While a considerable number of steamers are thus engaged, along the river, no particular interest attaches to their performances.

3. Rondout Line.— The Cornell Towing Company own or charter a large number of boats, the greater number of which are employed in and about New York harbor (q. v.), and between that city and Rondout. Two of their steamers, side wheelers, 205 feet long, forty feet wide, drawing seven and a half feet of water, and costing about $50,000, are engaged in towing between Albany and New York. (See above.) The Rondout tows consist of between twenty and thirty brick barges, coal boats and other vessels, picked up or left at various points along the river between the two cities. These are generally made up with four boats abreast and towed with two hawsers five inches in circumference and about 500 feet long.

4. Steam canal fleets.— The method of making up these fleets has already been described. They move at a somewhat greater speed than the large tows above described. As stated, the expenses of a fleet of four boats chargable to motive power are about $2,000 per season, with six round trips or eight and a

third cents per boat per mile, making the cost for a round trip between West Troy and New York twenty-five dollars per boat as against forty dollars charged by the towing lines, if light one way, or fifty dollars if loaded both ways. The actual expense is even less than twenty-five dollars as this is derived from a general average for whole trip between Buffalo and New York, while the coal consumption per boat per mile on the river, is much less than on the canal. In whatever light they are considered these steam canal fleets make an excellent showing.

For the above information concerning towing on the Hudson river, acknowledgment is due to the officers of the lines mentioned and to Hon. John H. Starin, of New York city.

Towing in and about New York Harbor and Long Island Sound.

Ship towing to sea.

In hauling sailing vessels out from dock, tugs alone are used. These vary from seventy to 125 feet in length, the engines having cylinders from twenty to thirty-six inches in diameter and twenty to thirty-six inch stroke.

Sailing vessels usually lie in slips, "head in," and when they are ready for sea, the tug comes to the end of the dock with head to the tide. A hawser six or eight inches in circumference is run through the hawser-pipe at the bow of the ship, along the outside of the ship to her stern quarter and thence to the stern bitts of the tug. A "slip line" is run through the quarter chock of the ship around the hawser and back through the chock. The tug then takes a strain on the hawser; all the ship's lines are let go save the bow line, which is rendered off as the ship moves out, but is kept in hand until all is clear, when it is cast off. When the ship is well out in the stream, one end of the slip-line is let go from the quarter chock and the ship swings around with head to the tug. The hawser is then paid out to a length of 500 or 600 feet and the ship is thus towed down the bay. Occasionally, wind and weather being favorable, the tug leaves the vessel at the narrows, nine miles down, but frequently the tug remains until the outer bar is passed, thirty miles from the city. The sails having been set on the way down, the ship now lays her course alone.

A pilot always accompanies these ships and is sometimes taken off by the tug, but more frequently by the station pilot boat outside the bar.

The tug may either return to the city alone or meet a ship desiring to be towed to the city. At other times the tug will leave New York at night, and run perhaps fifty miles from the city, lying to in wait for incoming vessels. If none are spoken during the day,, the tug will return as far as Sandy Hook, and lie at the dock, inside, over night, starting off shore again in the morning.

Mud-scow Towing to Sea.

This towing is done by all kinds of tugs, the mud-scows averaging 125 feet in length and thirty feet in width, with a capacity of about 400 cubic yards of mud. They are built with drop bottoms. The tows usually consist of four of these scows, securely lashed, end to end, with lines eight inches in circumference. The hawser employed is five and one half or six inches in circumference, and 350 to 500 feet long, fastened by bridles to each corner of the head scow.

Towing is only done with favoring tide. A permit is required for each scow on each trip. When the tow is abreast of Fort Hamilton, a shore inspector boards the tug and indicates the proper dumping ground, about thirty miles seaward from the city. The boats are dumped without stopping and then the return trip is made; the inspector, having taken up the permits, is put ashore at the fort and the scows are brought alongside the dredge, for refilling.

Schooner Towing through Hell Gate.

Heavy tows are never taken through Hell Gate, except with favorable tide. The towing is done by all classes of tugs. The usual tow consists of four schooners, securely lashed two on each side of the tug, the schooners usually supplying all necessary lines, which are about five inches in circumference. Lines are made fast from the stern and bow of each of the adjacent schooners to the stern and bow of the tug, and from bow to bow of the schooners. The fleet then proceeds up the East river to Riker's island, consuming about two hours with flood tide; the schooners are cast off, one at a time and proceed under sail. If then there are vessels in waiting, the tug will make up another tow and return with it to the city on the next ebb of the tide.

Railroad-float Towing about Harbor.

The largest car floats of the different companies are of nearly the same size, 225 feet long, thirty-four feet wide, drawing five feet of water when loaded, and carrying twelve cars, with a capacity of about 500 tons. The towing is done by tugs of the larger classes, many of which have compound engines. The lines employed are usually about five inches in circumference and are always supplied by the tug.

A line is passed from bow of tug to bow of float, and the tug then backs away until the slip is cleared. The line is then shifted to corner of float, whose headway causes the tug to swing around alongside, where she is made fast by bow, midship and stern lines. Towing is always done in this manner in fair weather. In rough weather, with a heavy sea runing, the tug will run her bow under the stern of the float and push it across the river into smooth water, where they make fast alongside and land in the proper slip.

General Towing about Harbor.

This consists of short trips with canal boats, barges, floats, coal boats, schooners, etc., and is done in various ways, depending upon the number of vessels and the places to or from which they are towed. The lines used vary from three and a half to five and a half inches in circumference.

In shifting canal boats and other similar vessels the number of these will vary from one to a dozen or even more. These may all be taken up by the tug without letting go of any of the others, or the tug may pull one out, taking it to the vicinity where the next one is lying; drop the first one in midstream and run in for the second, and so on for succeeding boats until the fleet is made up. This is either towed by a short hawser or lashed part on one side of the tug and part on the other. This process is reversed in distributing the boats of a tow.

In docking sailing vessels, the tug will make fast alongside with five-inch lines, land her on end of pier and work her around into the slip. When very large vessels are docked, two or even three tugs may be required, according to wind and tide. A tug will make fast on each side of vessel, landing her at the end of the pier and then let go of lines, pushing the vessel on the inside quarter until she is shoved into proper position in the slip.

Coal Towing between New York and Providence via Long Island Sound by the D., L. & W. R. R. Co.

The barges employed in this business are 200 feet in length, thirty-five feet wide, fifteen feet deep, and carry about 1,500 tons of coal. The towing is done by tugs, about 125 feet long, with engine cylinders about thirty-two inches in diameter and thirty-two-inch stroke of piston.

The barges are taken from the docks at Hoboken, one at a time, through the East river and Hell Gate to Riker's island, where they are anchored, the tug returning for others until the fleet is made up. This consists of three such barges, towed singly on eight-inch hawsers, 1,050 feet long between tug and first barge, and about 900 feet between successive barges, making the total length of fleet about 3,575 feet.

These barges are provided with three masts, on which are bent a fore stay-sail, fore and main sails and spanker. They also carry a steam windlass for hoisting anchor or sails and a steam siphon for pumping the hold. The sails are set through the Sound if the wind is favorable, and also supply a means whereby the barges may take care of themselves in case the tug is disabled.

Coal Towing on Long Island Sound by the Bee Line, Lehigh Valley Railroad Company.

The barges employed by this company are 175 feet long; draw from twelve to fourteen feet of water and carry about 1,200 tons of coal. The tugs are large, the largest being supplied with compound engines, having cylinders of twenty-four and forty-two inches diameter and thirty-inch stroke of piston.

This tug will take six such barges at a time, the tows being made up in the manner described in the preceding article.

The barges of this line are not supplied with masts, sails or steam power, but depend wholly upon the tug.

Acknowledgment is due to Hon. John H. Starin, by whom the very full information in regard to New York harbor has been furnished to this department.

The Illinois and Michigan Canal.

General description.

This canal connects the waters of Lake Michigan, at Chicago, with those of the Illinois river, at Lasalle. Its length is about 102 miles, and its dimensions are as follows: Water surface, sixty feet wide; depth, six feet; bottom width in earth forty-eight feet, and in rock sixty feet. There are fifteen lift and two guard-locks on the canal proper. With the exception of the Bridgeport lock, these are all of the general dimensions and character shown on accompanying plan, which has been furnished through the courtesy of General Superintendent James M. Leighton. These fifteen lift-locks overcome elevations aggregating 141.3 feet.

In the effort to dispose of the sewage of the city of Chicago, the original summit level of the canal was lowered, the work being completed in July, 1871, and from that time to the present the waters of the canal have been made more or less foul by the sewage thus carried. The flow of water necessary to maintain navigation was, however, not sufficiently large either to accommodate the sewage or to dilute it by draught upon Lake Michigan. The nuisance finally became intolerable and the city of Chicago constructed a new guard-lock at Bridgeport, of timber, 220 feet long and twenty feet wide in chamber, and erected a pumping station supplied with eight centrifugal pumps of a combined capacity of 60,000 cubic feet per minute. With these pumps running at their full capacity, the water in the canal is raised to a height of five feet above the elevation of mean lake. It is estimated that some 200 tons of solids are passed into the canal every twenty-four hours and in spite of the current induced (1.25 to 1.5 miles per hour, as the pumps are run), the canal commissioners are compelled to keep one dredge constantly at work upon the summit level, between Chicago and Lockport.

In addition to the canal proper, there are two dams and locks in the Illinois river. The first dam is located at Henry, thirty-eight miles below La Salle, the lock chamber being 350 feet long and seventy-five feet wide. The second, at Copperas creek, sixty miles below Henry, with lock of same size. The improved river is under the control of the canal commissioners. In addition to these, there have been surveys made for locks and dams at

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Beardstown, forty-seven miles below Copperas creek; at Bedford, forty-two miles further and at Six-mile islands, forty miles further, thus affording a six-foot channel from Chicago 330 miles, to Grafton, at the mouth of the river.

The structures along the canal bear a great resemblance to those of the Erie canal, and were in fact designed in many cases by the same engineers. Plate II shows a typical lock on this canal, traced from the original plan on file in the office of the canal commissioners, Lockport, Ill.

In the matter of maintenance similar methods are also pursued. A steam dredge and a sand pump are kept constantly employed, during the season of navigation, in maintaining the proper depth of water at a combined expense of about $11,200 (cost of running and repairs). These machines afford great satisfaction and do their work with great economy.

Tolls, trade and tonnage.

The great bulk of the canal traffic now consists of stone quarried between Chicago and Joliet. During the season of 1890 out of a total of 742,000 tons transported, over 600,000 were of stone.

On this article, the tolls charged are as follows:

CLASS.	Per cubic yard. Tolls in mills per mile.	Per cubic yard. Lockage in cents.
Dressed or sawed stone	10	15
Rubble stone	5	10
Dimension stone	8	15
McAdam stone	2	9

with the proviso: "That on stone transported over twenty-five miles, the tolls shall not exceed 12.5 cents per cubic yard on McAdam and rubble, and twenty cents per cubic yard on dimension and dressed or sawed stone."

The following table shows the time of official opening and closing of navigation from 1848 to 1890; the number of clearances issued, of boats running, of miles run and of tons transported, from 1860 to 1890 inclusive; and the number of steam canal boats running, for the years 1875 to 1890 inclusive, this distinction not having been made in the reports prior to 1875, although as will be seen later, steam canalers have been running since 1865.

					222	4,524	......	219	285,050	817,738	1869
....	April	7	October	8	184	2,903	......	179	242,650	585,870	1870
71........	April	6	November	25	234	3,523	......	186	278,948	629,975	1871

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STATISTICS ILLINOIS AND MICHIGAN CANAL, 1848 TO 1890.

YEAR.	Canal opened.	Canal closed.	Number days open.	Clearances issued.	NUMBER BOATS RUNNING.		Miles run.	Tons transported.	Year.
					Steam canal boats.	Total.			
1848........	April 19	November 29	224	....	......	......	....	....	1848
1849........	April 20	December 6	231	....	......	......	....	....	1849
1850........	March 22	December 6	259	....	.....	......	....	....	1850
1851........	March 15	December 8	269	....	......	......	....	....	1851
1852........	March 29	December 8	255	....	......	......	....	....	1852
1853........	March 14	December 12	274	....	......	......	....	....	1853
1854........	March 15	December 2	263	....	......	......	....	....	1854
1855........	April 3	December 12	253	....	......	......	....	....	1855
1856........	April 8	December 4	241	....	......	......	....	....	1856
1857........	May 1	November 20	204	....	......	......	....	....	1857
1858........	April 1	December 1	244	....	......	......	....	....	1858
1859........	March 16	December 3	263	....	......	.....	....	....	1859
1860........	March 8	November 26	264	3,926	......	201	235,684	367,437	1860
1861........	March 4	November 28	270	6,339	......	194	415,599	547,295	1861
1862........	April 1	December 3	247	7,044	......	211	474,976	673,590	1862
1863........	March 4	December 1	273	5,810	......	240	418,713	619,599	1863
1864........	March 10	December 1	265	4,527	......	228	300,340	510,286	1864
1865........	April 10	November 15	220	3,907	......	228	360,614	616,140	1865
1866........	April 11	October 31	203	5,488	.....	230	406,784	746,815	1866
1867........	April 10	November 15	220	4,183	......	209	357,623	746,954	1867
1868........	April 4	October 31	210	4,128	......	218	345,169	737,827	1868
1869........	April 7	November 15	222	4,524	......	219	285,050	817,738	1869
1870........	April 7	October 8	184	2,903	......	179	242,650	585,870	1870
1871........	April 6	November 25	234	3,523	......	186	278,948	629,975	1871

STATISTICS ILLINOIS AND MICHIGAN CANAL, 1848 TO 1890—(*Concludea*).

YEAR.	Canal opened.	Canal closed.	Number days open.	Clearances issued.	NUMBER BOATS RUNNING.		Miles run.	Tons transported.	Year.
					Steam canal boat.	Total.			
1872........	April 1	December 1	245	*5,018	......	172	334,820	783,641	1872
1873........	April 10	November 20	225	4,743	......	172	328,164	849,533	1873
1874........	March 30	November 20	236	4,296	......	152	288,075	712,020	1874
1875........	April 15	November 28	228	3,554	16	142	259,878	676,025	1875
1876........	March 25	November 18	239	4,049	22	145	302,024	691,943	1876
1877........	April 16	December 1	230	4,008	23	145	272,788	605,912	1877
1878........	March 20	December 1	257	4,299	25	140	293,335	598,792	1878
1879........	March 29	November 20	237	4,458	23	136	304,191	669,559	1879
1880........	March 22	November 18	242	4,536	25	133	320,009	751,360	1880
1881........	April 25	November 26	216	4,459	24	133	316,435	826,133	1881
1882........	March 13	November 30	263	4,055	23	132	335,710	1,011,287	1882
1883........	April 2	November 25	238	3,789	26	132	306,618	925,575	1883
1884........	April 7	December 1	239	4,204	27	134	325,431	956,721	1884
1885........	April 15	November 25	225	3,990	27	135	304,664	827,355	1885
1886........	April 1	November 25	239	3,783	28	130	303,575	808,019	1886
1887........	April 1	November 19	233	3,824	29	132	290,338	742,074	1887
1888........	April 10	November 15	220	3,326	29	127	267,771	751,055	1888
1889........	March 25	November 15	236	4,299	26	114	334,107	917,047	1889
1890........	April 1	November 21	235	2,920	25	104	260,713	742,392	1890
1891........	....	....	......	....	21	......	....	....	1891

* This and subsequent figures include clearances at Henry and Copperas creek.

Transportation.

Steam has entirely supplanted animal power on this canal. In 1885, there remained only four horse-boats and although there is one in nominal use at present, it is engaged in local trade only and is barely tolerated.

In August, 1865, three steam canal boats were brought from Ohio and introduced on the canal. They were the Atlantic, the Whale and the King Bros. They were of comparatively small size, carrying probably about 100 tons of cargo. Of the fate of the Atlantic, I have been able to learn nothing. The Whale ran continuously up to a year ago, when she was caught between a heavier vessel and a dock at Chicago, and collapsed. The King Bros. ran for many years as a freighter; she was finally altered into an excursion boat under the name "Frolic," and after some further use, sank about two years ago. Although she has been raised, her days of usefulness are probably over. Others followed these boats, but the next great improvement in method was introduced by Dr. Hanley, of Lockport, Ill. In the summer of 1868, this gentleman built two boats; the one a steamer of usual model, the other a consort, with concave stern, called a "boot-jack," made to fit the bow of the steamer. This pair securely fastened together, was called the "Novelty," and nicknamed "Hanley's Folly." The credit of the invention belongs to John Raymond, a resident of Lockport, with whom also originated the method now employed for coupling steamers and consorts, and described further on. This boat may fairly be termed the first attempted "double-header," and the forerunner of the "steamer and consort," as employed to-day. She made three trips to St. Louis during the season of 1868 and was then laid up and the engines changed. The new engines afforded sufficient power to enable her to tow two additional boats and in addition to trips through the canal and down the river, she towed two boats to St. Louis, 370 miles, and return, at $250 each. She was then sold and was employed in the lumber trade in Georgian bay; returning after three or four years, she was burned to the water's edge, but was raised and rebuilt and is running on the canal to-day with the original consort. The "boot-jack" stern however was found to be an element of weakness and a source of leakage and has since been remodeled. For this account I am indebted to Captain Henry G. Eddy, of Lockport, who ran her during the seasons of 1868 and 1869.

As stated, the "boot-jack" stern was not a success, and the inventor substituted the ordinary stern. To obtain that rigidity of coupling which is the characteristic feature of the "Illinois system," as distinguished from that of Mr. William Frick, Mr. Raymond made a recess in the stern wale of the consort to receive the stem of the steamer, and fastened the boats together by two iron bars (one on each side), bent at the ends to fit into eyes fastened to the hulls and furnished with turnbuckles in the middle to adjust the length and draw the boats tightly together. This method is the one altogether employed on this canal to-day and although not admitting of such ready adjustment as the modification employed on the Erie canal, serves the purpose very well.

The boats of to-day are built of oak, in a most substantial manner, 104 feet long over all; seventeen feet nine inches wide at deck and five foot water line and fourteen feet ten inches wide at bottom, to correspond with the shape of lock chambers. This cross-section is uniform in the case of a steamer for seventy-two feet of the length, the molded portion comprising twelve feet at bow and twenty feet at stern. In an unrigged barge the bow is the same as a steamer's, but the stern is more blunt, the molded portion occupying but eight feet of the length. The steamers carry cargoes of about 130-140 tons and the other boats about 156 tons, or a draught of four feet eight inches.

Of engines, there are nearly as many varieties as of steamers, but the practice with reference to screws is remarkably uniform. All but two of the steam canal boats are propelled by twin screws, usually a trifle over four feet in diameter. The screw shafts are connected to the crank shafts by beveled gear-wheels, one of each pair being furnished with wooden teeth. Contrary to my expectations, I found that these engines and wheels ran with no more perceptible noise than those of single-screw boats without gearing. The engines vary in every conceivable way. Single high-pressure, double high-pressure, single compound, with cylinders side by side, and double steeple compound engines were all represented. Some boats have locomotive boilers with fire door on the side, the engine being located on the opposite side of the boiler. As far as could be ascertained, the compound engines are all supplied with independent feed, air and circulating pumps.

All boats use the Illinois soft coal, but the reported rates of consumption are so various as to render an average of no value. It would appear that the steam fleets run at a rate of between three and four miles per hour, through the water, when loaded, and between four and five miles an hour when light; consuming between thirty-five and sixty-five pounds of coal per loaded boat per mile.

The steamers carry a captain, two engineers, one steersman, one cook and one man on each boat in tow. The wages paid at present are for captains and engineers, between sixty-five dollars and seventy-five dollars per month; for steersmen, between one dollar and fifty cents and one dollar and seventy-five cents per day; and for cooks, between twenty dollars and twenty-five dollars per month and board.

The current in the canal will probably average less than 0.3 miles per hour from Joliet to La Salle. Between Chicago and the Desplaines river, the velocity varies with the rate of pumping; the present average being between 1.25 and 1.50 miles per hour.

Fleets in the stone trade vary in size, according to the pressure of business. Rubble stone is loaded and unloaded by derricks on "boats" about three feet wide and five feet long, thus saving much time which would otherwise be lost in handling, the "boats" being brought back by the fleet and refilled at the quarry.

All fleets in the through trade consist of four boats, viz.: Steamer pushing one consort and towing two, the boats in tow being strung out singly on hawsers one and one-half to two inches in diameter, and between 200 and 300 feet long. Such a fleet will run from La Salle to Chicago, about 100 miles, in forty-eight hours, running only in daylight. Of this time, about thirty minutes is consumed in delays at each lock, making the running time about forty hours, or at the rate of 2.5 miles per hour over the ground, against a current of from 0.3 to 1.5 miles per hour.

There are no provisions at locks for manipulating gates by machinery, save capstans on the river locks.

The successful use of twin screws is a notable feature of this canal. Stringent regulations are enforced to prevent the deposition of rubbish in the canal and very few screws are broken. The steamer Advance is still carrying one of the original screws applied when she was built, in 1875, and in continuous service since.

As shown by table on a preceding page, the average length of the season of navigation on this canal, since 1848, has been 239 days, and in this connection it is worthy of mention that although a date is set for officially closing, the levels are not emptied and navigation is permitted until prevented by ice, with obvious benefit to boatmen.

For the greater part of the information above summarized, I have to acknowledge my indebtedness to Mr. James M. Leighton, general superintendent, as well as for unbounded courtesy during the brief period which I was able to devote to the study of the waterway he is so efficiently and economically maintaining.

Coal Transportation on the Ohio River.

Although this traffic is not strictly comparable with that of our New York canals and connecting waterways, being unique in itself, it is nevertheless of great interest, and the mode of transportation highly economical, as will be seen later on.

General description.

The coal which plays so large a part in the traffic of the Ohio river, is derived from collieries on the Alleghany, Monongahela and Youghiogheny rivers. It is brought from the mines along these streams in comparatively small lots, in the coal boats, barges and flats which at Pittsburg are made up into tows as described later on.

The navigation of the Monongahela river is accomplished by means of locks and dams, at present nine in number, located as shown in following table:

MONONGAHELA SLACKWATER NAVIGATION.

NUMBER OF LOCK AND DAM.	DISTANCE IN MILES.		DIMENSIONS OF CHAMBERS.				Power for gates	Owned by	Tolls from above lock to Pittsburg, per 1,000 bushels of coal.
			SOUTH LOCK.		NORTH LOCK.				
	Between locks.	From Pittsburg	Length.	Width.	Length	Width.			
1	12	0	160	50	217	56	Steam	Monongahela Nav. Co.	$0 90
2	10	12	160	50	217	56	Steam	Monongahela Nav. Co.	1 80
3	12	22	160	50	260	56	Steam	Monongahela Nav. Co.	2 45
4	*18	34	160	50	225	56	Steam	Monongahela Nav. Co.	2 65
5	*10	52	160	50	None.	None.	Hand	Monongahela Nav. Co.	2 85
6	*12	62	160	50	None	None.	Hand	Monongahela Nav. Co.	3 05
7	*4	74	160	50	None.	None.	Hand	Monongahela Nav. Co.	3 05
8	*5	78	160	50	None.	None.	Water	U. S. government	†
9	....	88	160	50	None.	None.	Hand	U. S. government	†

The development and present magnitude of this branch of the coal trade is shown by the amounts passing through these locks, as follows:

1845, 4,605,000 bushels,§ or 184,000 tons.

1855, 22,234,000 bushels, or 889,000 tons.

1865, 39,582,000 bushels, or 1,583,000 tons.

1875, 62,000,000 bushels, or 2,480,000 tons.

1885, 105,000,000 bushels, or 4,200,000 tons.

1890, 116,303,000 bushels, or 4,652,000 tons.

1891, 90,000,000 bushels, between March ninth and December twenty-sixth.

Of the coal brought to Pittsburg, some is there consumed, but the greater portion is taken down the river to supply the markets of Cincinnati, Louisville, St. Louis and New Orleans, and intermediate points.

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* Estimated. † No tolls along government improvement. § The coal bushel contains 2,688 cubic inches and weighs 76 pounds.

Below Pittsburg there are two interruptions to continuous navigation, viz., the dam at Davis island and the falls at Louisville. Fleets pass over the dam during the high stages of the river, the lock being used only occasionally. At Louisville the boats run over the falls when the depth of water over the natural rock dam is not less than nine and one-half feet. At lower stages, the descent or ascent is accomplished by the canal around the falls.

With the exceptions of bridges crossing the Ohio and Mississippi rivers, there are no other obstacles to navigation. Steamers and fleets will often tie up in preference to attempting the passage between the piers of some of these bridges during the night.

Coal Boats, Barges, etc.

The nature of this waterway, navigable in the upper portion during high stages of the river only, and swift in current throughout, has brought about the development of a peculiar method of transportation. Four kinds of carrying vessels are employed.

1. Coal boats.— These are merely large boxes, built of hemlock, one and one-half inches thick, and are made 170 to 175 feet long, twenty-six feet wide and nine or ten feet deep. They are loaded to draw about seven and one-half feet of water and will hold about 25,000 bushels, or 1,000 tons, of coal, and cost about $650. They are employed between Pittsburg and points below Louisville. They are sold with the coal, a certain price per barrel (2.6 bushels) for the coal, including the vessel. Planters along the Mississippi break them up and employ the timber for various purposes. When sold to the trade in New Orleans, they are sometimes bought back at a nominal price (about seventy-five dollars), returned to Pittsburg and used for another trip or two, but never for more than three trips. Of about 1,500 sent down the river annually, not more than 250 are so returned, and these must, of course, be in the best condition.

2. Coal barges.— These are substantial craft, built of six-inch pine in the most durable manner, of model similar to canal boats, 130 to 135 feet long, twenty-six feet wide and loaded to draw 7.5 to eight feet deep. They will hold from 13,000 to 15,000 bushels of coal, and cost between $1,200 and $1,400. They are used for

the upper markets, Cincinnati, Louisville and, sometimes, St. Louis, and last about twelve years in service.

3. Fuel boats.— These are similar to barges; are built about ninety-five feet long and twenty feet wide and are loaded to draw about four feet of water, holding about 7,000 bushels. They cost between $600 and $700, and last about ten years. They are employed in carrying the fuel for the steamer managing a tow.

4. Flats are somewhat smaller, about ninety feet long and sixteen feet wide, and hold about 4,000 bushels.

Towing Steamers.

In accompanying table of "Data concerning towing steamers" Nos. 20 to 38 will show the various dimensions of steamers engaged in this trade. The smaller ones bring the coal from the mines to Pittsburg; those of medium size are used between Pittsburg and Louisville and the larger ones between Louisville and New Orleans.

These steamers are fitted up in the best manner; their large size affording room for commodious quarters for the officers and crew. The largest of them are manned as follows: Captain, mate, two engineers, eight firemen, two pilots, two assistant pilots, or "strikers," sixteen deckhands, watchman, steward, cook, helper and chambermaid; thirty-seven in all; the large force of deckhands being needed to manage the boats in "tow." Their costs vary with prices of material, some of the largest having cost as much as $85,000.

Engines.— The boats being all "stern-wheelers," the engines are double. Fuel being cheap, only high-pressure engines are employed in order that the machinery may be made as light as possible, every saving in draught effecting proportional increase in the length of periods during which the steamer may navigate. A peculiarity deserving description is the placing of a duplicate pair of exhaust pipes from the engine to the paddle wheel at the stern, the hot steam thus serving to prevent the formation of ice on the wheel while running.

In addition to the main engines, these steamers have what is termed a "doctor," i .e., an auxiliary feed pump by which water is pumped through the heaters into the boilers; and one or more auxiliary engines to work capstans, etc. The larger boats are supplied with auxiliary engines to run dynamos, maintaining the powerful search lights with which they are supplied.

Steam follows nearly full stroke in the main engines, which make about twelve or fifteen revolutions per minute going down the river and about fifteen or twenty coming up. The "doctor" making between five and seven and between eight and ten correspondingly.

Boilers.— The most striking features of these boats, however, are the boilers. The dimensions of these are very uniform, ranging from twenty-six to thirty feet in length and from thirty-eight to forty inches in diameter, with two large flues running the full length.

This type has been evolved to meet the requirements of a service on streams carrying so large a percentage of silt, etc., and tubular boilers can not be used. To a person accustomed to a tubular boiler using tolerably clear water and lasting for some years without any considerable repairs, the equanimity with which an Ohio or Mississippi river boatman will learn that one of his boilers has burned out, is very striking. But with the boatmen, this is an old story for a boiler burns out every few trips, sometimes on the first one, and sheets are kept in stock, cut and drilled, ready to be applied at any time.

These boilers usually work under a pressure of 165 to 175 pounds per square inch.

Fuel consumption.— The coal burned is "slack" and with fuel so plenty, and costing only the expense attached to mining it (the large producers being also the large shippers and transporters), little attention is paid either to the actual consumption or to means for its reduction. The only data I have been able to obtain, are, that one of the largest steamers, coming up with a tow of empty barges and boats, will burn from 1,000 to 1,500 bushels (thirty-eight to fifty-seven tons), every twenty-four hours, running against the current at a speed of four or five miles per hour over the ground. Descending with a "tow," this consumption is reduced to 700 or 800 bushels (twenty-six or thirty tons) every twenty-four hours.

DATA RESPECTING TOWING STEAMERS.

Number.	NAME.	Home port.	Owned by	Hull.					
				Material.	U. S REGISTRY — TONS.		Length, feet.	Breadth, feet.	Depth, feet.
					Gross.	Net.			
1	Robert H. Cook	Plattsburgh, N. Y	N. Y. and L. Champlain Transp. Co.	Iron	157.62	78.81	102.0	21.0	9.6
2	E. L. Levy	" "	" " "	"	142.12	71.06	104.5	21.5	8.6
3	H. G Tisdale	" "	" " "	"	81.83	40.92	94.0	18.8	8.7
4	Germania	" "	Champlain Towing Co	Wood	88.86	44.43	90.4	19.4	9.1
5	E. C. Baker	" "	Lake Champlain Transp. Co.	Iron	153.65	76.85	102.0	21.6	9.0
6	William Fuller	Albany, N. Y.	" "	Wood	43.74	26.34	64.5	15.0	7.8
7	J. G Witherbee	Plattsburgh, N Y	Port Henry Towing Co., N Y.	Iron	114 45	57.23	106.8	20.5	8.8
8	Conqueror	Montreal	Sincennes-McNaughton Line (Ltd.)	"	233.04	24.47	136.6	21.7	11.85
9	Hudson	"	" " "	W'd & steel.	156.18	79 89	128.5	25.1	6.4
10	Georgiana	"	" " "	Wood					
11	John Young	"	" " "	"	163.99	103.32	125.0	22.0	8.1
12	Silver Spray	"	" " "	"	130.56	99.06	75.0	16.0	9.0
13	John	"	" " "	"	203.88	99 07	107.5	21.6	8.0
14	Dandy	"	" " "	"	27.92	12.66	*48.0	13.0	5.6
15	Thomas H. Nasmyth	"	" " "	"	49.20	36.46	56.0	15.0	7.8
16	W. C. Francis	"	" " "	"	38.00	14.00	65.0		
17	Calumet	"	" " "	"	40.35	27.44	66.0	15.3	8.0
18	W. F. Logie	"	" " "	"	17.82	11.78	47.6	12.0	6.0
19	Elfin	"	" " "	"			80.0		
20	John F. Walton	Pittsburgh	Joseph Walton & Co	"	485.04	468.04	177.0	34.0	6.5
21	Coal City	"	" "	"	361.94	361.94	170.0	32.4	4.9
22	Samuel Clark	"	" "	"	435.82	435.82	175.0	33.0	6.0
23	Joseph Walton	"	" "	"	300.27	300.27	158.0	27.0	5.0
24	Joseph Nixon	"	" "	"	307.71	307.71	163.5	26.8	5.0
25	Nellie Walton	"	" "	"	148.54	148.54	124.0	22.0	4.5
26	I. N. Bunton, No. 2	"	" "	"	195.06	142.56	181.0	28.4	4.0
27	Maggie	"	" "	"	193.14	184.09	181.0	21.0	4.0
28	Harry Brown	"	W. H. Brown Sons	"	772.15	772.15	210.0	49.6	6.0
29	Alice Brown	"	" "	"	551.36	551.36	193.0	34.0	4.0
30	Charles Brown	"	" "	"	544.12	544.12	200.0	33.0	6.0
31	Sam Brown	"	" "	"	474.10	474.10	177.0	39.0	7.2
32	Mariner	"	" "	Steel					
33	Percy Kelsey	"	" "	Wood	244.67	244.67	148.0	31.0	4.0
34	Jim Brown	"	" "	"	153.40	153.40	135.0	24.3	4.0
35	Voyager	"	" "	"	218.35	146.47	134.4	23.8	4.1
36	Cruiser	"	" "	Steel					
37	Charlie Clark	"	" "		147.69	147.69	181.0	28.6	4.3
38	Volunteer	"	" "						

* Lengthened to 75 feet — gross tons, 46.00; net tons, 15.00.

DATA RESPECTING TOWING STEAMERS—(*Continued*).

Number.	NAME.	BUILT			ENGINE.		CYLINDER.	
		In	At	By	Kind.	Built by	Diam.	Stroke.
1	Robert H. Cook	1882	Buffalo, N. Y	David Bell	Compound	David Bell	18, 34"	26'
2	E. L. Levy	1888	Philadelphia	Neafie & Levy	"	Neafie & Levy	20, 36"	26'
3	H. G. Tisdale	1862	"	" "	Simple condensing	" "	25"	24'
4	Germania	1880	Newburgh, N. Y	Ward Stanton & Co.	" "	Ward Stanton & Co.	22"	24'
5	E. C. Baker	1889	Philadelphia	Neafie & Levy	Compound	Neafie & Levy	20, 40"	26'
6	William Fuller	1882	Athens, N. Y	Van Loon & McGee	High pressure	Wm. McCune (Troy)	16"	16'
7	J. G. Witherbee	1872	Philadelphia	Neafie & Levy	Compound	Neafie & Levy	18, 34"	24'
8	Conqueror	1871	Renfrew, Scotland		Low pressure		36"	66'
9	Hudson	1891	Sorel, P. Q	Louis Beaulac	Compound	J. A. Pontbriand	22, 42"	72'
10	Georgiana		Buffalo, N. Y		High pressure		20"	22'
11	John Young	1875	Montreal	W. P. Barthy	Double low pressure	W. P. Barthy	30"	96'
12	Silver Spray	1869	Sandusky, O.		Compound		15, 26"	22'
13	John	1872	Sorel, P. Q	Frechette & Gerard	Low pressure	George Brush	32"	96'
14	Dandy	1864	Buffalo, N. Y	Van Slyke & Notter	Compound		12, 21"	18'
15	Thomas H. Nasmyth	1874	" "	Gibson & Craig	High pressure	Sutton Bros	18"	20'
16	W. C. Francis	†1876	" "		" "		18"	20'
17	Calumet	1873	" "		" "	Ponud Manuf'g Co	18"	18'
18	W. F. Logie	1881	" "	O'Grady & Maher	" "	Sutton Bros	18"	14'
19	Elfin				" "	Double	14"	18'
20	John F. Walton	1870	Pittsburgh		" "	"	24"	108'
21	Coal City	1864	"		" "	"	24"	96'
22	Samuel Clark	1870	"		" "	"	22"	108'
23	Joseph Walton	1873	"		" "	"	20"	84'
24	Joseph Nixon	1877	"		" "	"	20"	84'
25	Nellie Walton	1873	"		" "	"	17"	72'
26	I. N. Bunton, No. 2	1884	"		" "	"	17"	60'
27	Maggie	1881	"		" "	"	14"	84'
28	Harry Brown	1879	"		" "	"	26"	120'
29	Alice Brown	‡1871	"		" "	"	26"	108'
30	Charles Brown	†1872	"		" "	"	22"	96'
31	Sam Brown	1881	"		" "	"	20"	96'
32	Mariner	1890			" "	"	21"	84'
33	Percy Kelsey	1882	Pittsburgh		" "	"	18"	72'
34	Jim Brown	1881	"		" "	"	16"	72'
35	Voyager	1885	"		" "	"	17"	66'
36	Cruiser	1890			" "	"	18"	84'
37	Charlie Clark	1889	Pittsburgh		" "	"	16"	60'
38	Volunteer	1891			" "	"	17"	72'

† Rebuilt in 1888. ‡ Rebuilt in 1889.

DATA RESPECTING TOWING STEAMERS — (*Concluded*).

Number.	NAME.	Cut-off, inches	Vacuum by gauge, inches.	Boilers.					Screw.	
				Kind.	Material.	L., Feet.	S., Inches.	Pressure, lbs.	Diam.	Pitch.
1	Robert H. Cook	10–12	26	Horizontal	Steel	14½	103	95	8'-1½"	11'
2	E. L. Levy	8–10	26	"	"	14½	108	105	8'-5"	12'
3	H. G. Tisdale	7–10	25½	"	Iron	13	96	70	7'-8"	10'
4	Germania	6–8	25½	"	"	14	96	80	8'-2"	10'
5	E. C. Baker	12–13	25½	"	Steel	12	145	95	8'-6"	?
6	William Fuller	9	......	"	Iron ?	11¾	......	85	6'-0"	?
7	J. G. Witherbee	8	25½	"	Steel	16	108	115	8'-0"	11'
8	Conqueror	......	......	......	......	......	......	40	Paddles.	
9	Hudson	......	......	......	......	......	......	125	"	
10	Georgiana	......	......	......	......	......	......	85	Screw.	
11	John Young	......	......	......	......	......	......	50	Paddles.	
12	Silver Spray	......	......	......	......	......	......	125	Screw.	
13	John	......	......	......	......	......	......	40	Paddles,	
14	Dandy	......	......	......	......	......	......	90	Screw.	
15	Thomas H. Nasmyth	......	......	......	......	......	......	100	"	
16	W. C. Francis	......	......	......	......	......	......	125	"	
17	Calumet	......	......	......	......	......	......	85	"	
18	W. F. Logie	......	......	......	......	......	......	100	"	
19	Elfin	......	......	......	......	......	......	100	Twin screw.	
20	John F. Walton	5/8–3/4	......	Horizontal	No. 6	26	40	......	Stern wheeler.	
21	Coal City	5/8–3/4	......	"	6	26	40	......	"	"
22	Samuel Clark	5/8–3/4	......	"	6	26	38	......	"	"
23	Joseph Walton	5/8–3/4	......	"	5	26	40	......	"	"
24	Joseph Nixon	11–16	......	"	4	26	40	150	"	"
25	Nellie Walton	5/8–3/4	......	"	3	......	......	......	"	"
26	I. N. Bunton, No. 2	5/8–3/4	......	"	3	......	......	......	"	"
27	Maggie	5/8–3/4	......	"	3	......	......	......	"	"
28	Harry Brown	5/8–3/4	......	"	7	28	40	165	"	"
29	Alice Brown	5/8–3/4	......	"	6	28	40	165	"	"
30	Charles Brown	5/8–3/4	......	"	5	28	40	165	"	"
31	Sam Brown	5/8–3/4	......	"	5	26	40	174	"	"
32	Mariner	5/8–3/4	......	"	5	26	40	......	"	"
33	Percy Kelsey	5/8–3/4	......	"	4	26	38	......	"	"
34	Jim Brown	5/8–3/4	......	"	3	28	40	174	"	"
35	Voyager	5/8–3/4	......	"	3	26	40	......	"	"
36	Cruiser	5/8–3/4	......	"	4	28	40	......	"	"
37	Charlie Clark	5/8–3/4	......	"	3	26	38	......	"	"
38	Volunteer	5/8–3/4	......	"	3	30	40	......	"	"

Management of Fleet.

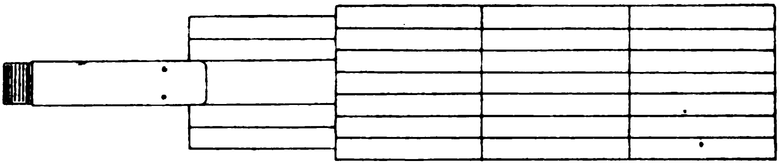
The boats destined to compose a fleet, are brought down the Monongahela to Pittsburg, three at a time, by the smaller steamers with say, sixteen-inch by six-foot cylinders. Here they wait until the river has reached a "boating stage" (occurring from ten to fifteen times in a year), sufficient for the shipment of coal boats and barges drawing from six to seven and one-half feet of water. When this occurs, the larger steamer will take six coal boats or twelve barges as far as Safe Harbor, whither she is followed by a smaller steamer with the other four boats or five barges which go to make up the usual fleet between Pittsburg and Louisville. This division of fleet is made on account of difficulties of navigation between Pittsburg and Safe Harbor. The fleet is then made up in a manner similar to that shown on accompanying sketch. The boats are clustered about three abreast, with two astern; the steamer's bow projects between the two stern boats only about twenty feet; the smaller boats containing fuel are lashed to the sides of the two stern boats as in sketch. By powerful cables, the whole fleet is lashed together with the assistance of the capstans and auxiliary engines and floats down the river, with the steamer astern, not unlike the fleets formed by steam canalers on the Hudson river, only on a very much larger scale. As stated, the engines make perhaps twelve revolutions per minute going down the river. With a wheel twenty-one feet in diameter, and allowing sixty per cent slip, this is equivalent to a little over three miles per hour, speed through the water, which, added to velocity of current of three, four or five miles per hour, makes a very respectable rate of travel for so unwieldy a mass.

The fleet thus travels down the river, the steamer not only propelling and steering with her large triple rudders, with resisting surfaces of 150 to 175 feet, but also backing at times when "flanking" a dangerous bend. In this manner the trip to Cincinnati, or Louisville, is accomplished.

At Louisville, as previously stated, the falls are run when there is an available depth of nine feet of water; the steamer taking one-half the fleet down first and returning from the foot of the rapids for the remainder. When it is necessary to go through the canal, the fleet is broken up. The steamer backs, wheel foremost, through the canal, towing the boats, two abreast, to the locks. The steamer locks down and the boats follow, three at a time, three abreast in the locks. This operation usually involves twenty-four hours' delay to fleet, while there is sometimes a delay of a week spent in waiting to get through the canal.

Between Louisville and New Orleans the towing season is from December to July.

At Louisville, the fleets are made up of from twenty to thirty coal boats, as shown in following sketch, and described in preceding paragraph:



The largest steamers are employed in this last section, between Louisville and New Orleans, but, except the difference in size of fleets, the method is the same.

Speed of travel.— Between Pittsburg and Louisville, tows run at a rate of six or seven miles per hour down, and four or five miles per hour up stream. The running time to Louisville, 600 miles, is about four days; from Louisville to Cairo, 400 miles, three days; from Cairo to New Orleans, 970 miles, sixteen days may be consumed, including delays and stoppages. Returning, with tows, the steamers make about four miles per hour over the ground; without tows, nine or ten miles per hour. A fair average period for a round trip between Louisville and New Orleans is thirty days.

General.

An acre of coal land will yield about 100,000 bushels. The coal sells in New Orleans for twenty-five to thirty-five cents per barrel (of 2.6 bushels of 2,688 cubic inches each), coal boats included.

The cost of transportation of coal from Pittsburg to New Orleans is estimated by a prominent shipper at about one dollar per ton, or 0.51 mills per ton, mile.

Historical.

We have now discussed the methods in vogue along this waterway to-day, and the following abstract from "Pittsburg's progress, industries and resources," by George H. Thurston, 1886, furnishes a valuable record of the various stages of their development.

The ship Louisiana, of 350 tons burden, was built in Pittsburg, in 1803, and ballasted with coal which was sold in Philadelphia for thirty-seven and a half cents per bushel. "This was no doubt the first transportation of Pittsburg coal by way of the river to a market, although the first floating of coal in flat boats from Pittsburg down the river to points on the Ohio, was by Thomas Jones in 1817. George Shiras, Sr., in a letter to William M. Lyon, dated June 8, 1884, says: "The first person that I knew to take coal down the Ohio river was 'Pilot Tom' Jones, son of Thomas Jones, who ran and owned the ferry from the foot of Liberty street to his landing on the opposite side of the Monongahela river. Their pit was not far up the river from O'Hara's burning pit. The coal was brought down the hill on a 'sled car' driven by Pilot Tom, and placed in piles on the bank of the river during the winter, and in the spring when the 'flat boats' arrived from 'French creek,' Jones would purchase a pair, hire four or five stout, young Irishmen, and have his coal wheeled into the boats, lay in a stock of provisions, jump aboard the boats with only the stearing oars at bow and stern, cut loose, and not attempt to land until he reached Maysville, Kentucky, where he first commenced to make sales; and from this place he would take a fresh start for Cincinnati." One, Louis Sweeny, was, according to Daniel Bushnell, also engaged in floating coal from Pittsburg at an early day, and he thinks at the same time with Thomas Jones. "The first coal transported from the vicinity of Monongahela City was in 1819. The coal was mined from a pit under the present cemetery, hauled by road wagons to a point at the mouth of Pigeon creek, and loaded into a boat owned by Edward Kearney, after which it was floated to Pittsburg. The boat was built by Isaac and Abraham Vanvoorhis, and measured forty feet in length by twelve feet in width, holding about 700 bushels." *

This method of taking coal to the markets at points on the Ohio below Pittsburg was the only one for several years. The "French creeks," as the boats were called, from a tributary of the Alleghany, where they were built, were loaded with from 4,000 to 6,000 bushels of coal, These boats were lashed in pairs with ropes and floated to market under charge of a crew of five men, the chief care of the boatmen being to keep the boats in the proper channel of the river. Even under this primitive method of transportation the coal trade of Pittsburg continued to increase and coal lands on the Monongahela river in the near vicinity to advance in value. The day arrived, however, when a few enterprising men began to discuss the feasibility of towing coal.

"The writer recollects well how the proposition to tow the unwieldy 'French creeks' was received by the 'coal boatmen' and was ridiculed. The term 'crank" had not then been coined, but those who talked of towing coal as a feasible thing were at that day spoken of as such under a more common name, and conservative business men shook their heads wisely and smiled dubiously. As the coal boats had to be floated to market on flood waters, it did, to those acquainted with the rapid currents of the Ohio in the spring and fall rises and the June freshets, seem a dangerous business to attempt to tow those huge unwieldy bulks of coal in flat-bottomed, box-shaped boats through the crooked channel and sharp bends of the river. But in 1845 Daniel Bushnell began towing coal down the Ohio with a small stern-wheel boat called the 'Walter Forward,' making a trip to Cincinnati as an experiment with three coal flats loaded with 2,000 bushels each. In the same year Judge Thomas H. Baird began towing coal to Hanging Rock, Ohio, with a side-wheel boat called the 'Harlem' and two 'Model' barges bringing back pig-metal. In the fall of 1849 Hugh Smith began to tow coal to the lower markets with a steam towboat, 'Lake Erie.' During 1849 Daniel

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* J. Sutton Wall's report to the Geological Survey, 1884.

Bushnell built the 'Black Diamond' towboat to tow coal to Cincinnati and to New Orleans in 1850, from which date towing coal, as it was called, superseded altogether the floating system.

"The term towing is a misnomer, as the boats and barges containing the coal are propelled instead of towed. Although this is an old song to Pittsburgers and many along the river, yet to others it may not be uninteresting to be told that a tow, as it is called, is made up of one towboat and from ten to fourteen barges, coal boats and flats, and from one to four fuel boats, filled with slack coal for boiler fuel during the trip. These boats are all placed in front of the towboat except one on each side of the steamer, all securely lashed together, forming a compact mass about 350 feet long and 150 feet wide, and holding from 500,000 to 700,000 bushels or about an average of 24,000 tons, being the yield of from five to seven acres of coal land, according to size of the 'tow' so-called. Of such 'tows,' from eight to ten in a day, in the coal boating stages of the Ohio, leave the harbor of Pittsburg for all points below as far as New Orleans, and there are now from ninety to 100 towboats, varying in cost from $8,000 to $30,000, employed in thus propelling coal, being the growth in forty years from the little 'Walter Forward,' with her three flat boats, holding 6,000 bushels, or about 240 tons of coal.

* * * * * * * *

"A tow of coal made up of these various descriptions of boats to the number, as before stated, of eighteen, barges, canal boats and flats, with the tow-boat, and loaded with the average of 600,000 bushels or 24,000 tons coal, represents a value of $80,000 as it leaves the harbor of Pittsburg. As before stated, eight or ten of such massive islands, as it were, of coal, equal in surface to one and a quarter acres, and floating the coal product of from six to seven acres of coal land, depart in the boating stages of the Ohio from Pittsburg. The 'driving,' for such it almost seems to be, in its handling by the deft pilot, who, with sinewy arms, whirls and rewhirls the wheel that guides the boat and this mass of coal, is a task to which only those brought up to the trade are competent. Skill, judgment, nerve, are all called into play as the ponderous bulk, borne along on a river at flood height, running at a current of eight to ten miles an hour, sweeps onward. Through narrow channels, around sharp bends, between the stone piers of bridges, where a misturn of the wheel, a failure of judgment, a miscalculation of distance, means disaster and wreck, the pilot guides the tow, now backing, now flanking, now pushing, now floating, watchful and cool, the pilot does his work. There is probably no such boatmanship shown anywhere else in the world as is displayed by the Pittsburg tow-boat pilot. Watching one of these ponderous tows surging down the river with a little tow-boat, of, perhaps, ninety to 100 feet in length and twenty to twenty-five feet in width at its rear, turning it round bends, flanking it past points, backing and checking it in narrow channels, one can not but think of the old joke of the tail wagging the dog; and here it does it, and does it well. It is a wonderful exhibit of skillful navigation, the thus handling, by the nervy grip of one man on a wheel, a bulk of 30,000 tons, moving at a speed of from twelve to fifteen miles an hour down such a tortuous stream as the Ohio, and with perhaps not five feet to spare of channel width or two feet of water depth."

For the information compiled above I am indebted to Messrs. Wm. H. Brown's Sons, Jos. Walton & Co. and John A. Wood & Son, and, as well, for many courtesies extended while obtaining it.

Conclusion.

Although every effort has been made to present the facts concerning the traffic and means of transportation along the various waterways referred to in as compact form as possible, this report has assumed much greater proportions than at first anticipated.

In conclusion, it may be said that, taking into consideration the circumstances governing the different cases, and making due allowance therefor, there has been developed on our Erie canal a system of transportation which reflects the greatest credit upon the boatmen, to whose intelligent efforts its evolution must be attributed, and which will suffer by no comparisons to which it can be subjected to-day.

Very respectfully submitted.

AUG. S. KIBBE,
Assistant Engineer in Charge.

INDEX.

A.

PAGE.

Abandoned canals 56
Appendix A 65–124
Appendix B 125–187
Appendix C 187–382
Appendix D 383–402
Appendix E 403–494
Appraisal of county lands 52
Appropriations on M. D. 206–212
Aqueducts 6, 132–138–389

B.

Belgium system on Erie canal 48, 456–459
Bridge at Church street, Schenectady 136
Bridge at Main street, Fultonville 136
Bridge at West Troy 137
Bridge, number of 6
Bridges on New York State canals 69–71
Bridges on western division 389–91

C.

Canal, Champlain, opening of 5
Canal, Champlain, transportation on 459–60
Canal, completion of the 14
Canal, Erie, first ground broken on 13
Canal, Erie, first beginning of 5
Canal, first boat over the 5
Canal, in 1891 53
Canal, length of 6
Canal, number of structures on 6
Canal, Oswego, first opened 5
Canal, reservoirs on 72
Canal, transportation in 1891 on 403–405
Canal, width of old 6
Canal, width of present 6
Coal boats, barges, etc 483–484
Coal towage on Ohio river 50–52
Coal transportation on Ohio river 481–483
Commercial canals in New York 5

PAGE.
Commission of the Port of New York 52
Commission of the land office 52
Commission to supervise repairs and improvements of quarantine establishment 52

D.

Dams on W. D 386
Dams, number of 6
Data as to steam canal boats on canals 24–29
Ditching and draining 204
Double headers first used 20
Dredging Albany basin 135

E.

Early improvement of water communication in New York State 10–11
Enlargement of canal 14
Engineering expenses of department for 1890 73–75
Engineering organization of E. D 143

F.

Former attempts to introduce steam on canal, *i. e.*, 1871 410

H.

Highway bridges 57
Historical résumé of Illinois and Michigan canals 491–494
Horse boat transportation on Erie canal 1891 425

I.

Illinois and Michigan canal 474–481
Improvement of channel 198
Improvements recommended 57
Improvements of Saranac river 143
Introduction of steam propulsion 15–20

L.

Lift bridges 54
Lift bridge at Church street, Schenectady 136
Lift bridge at West Troy 137
List of bench marks in M. D 342–378
Locks, aggregate lift of 5
Locks, E. D 6
Locks, number of 7
Locks in W. D 8

M.

Machinery for hauling boats on locks 198
Managements of fleets 489
Methods of transportation on canal 8, 9

N.

PAGE.

Navigation, M. D. 194–197

P.

Performance of boats, 1891 431–434
Prisms, banks, docking, etc 130–137

R.

Report State Engineer 5–64
Report Division Engineer, E. D. 123–143
Repairs to Moyer creek 136
Result of observations of steam canal boats 30–48
River improvement, M. D. 194

T.

Time required for locking boats 446–452
Tolls, trade and tonnage New York State canal 452–455
Tonnage of Champlain canal, 1857–1891 461–465
Towing on Hudson river between Albany and New York 467–470
Towing in and about New York harbor and Long Island sound 470
Towing of mud scows at sea 471
Towing railroad floats about harbor 472
Towing in general 472
Towing coal on Long Island sound 475
Towing steamers 484
Transportation between Whitehall and Montreal 463
Transportation between Whitehall and St. Johns 464
Transportation between St. Johns and Chambly on canal. 465
Transportation between Chambly Basin and Montreal 465–467

W.

Walls and banks 203
Walls, vertical 391
Walls at Whitehall 140
Water record Cayuga and Cross lakes and Seneca river 250–255
Waste weirs 138
Work under contract 62